

ALASKA DEPARTMENT OF FISH AND GAME
SUMMARY OF THE 1999 MANDATORY SHELLFISH
OBSERVER PROGRAM DATABASE FOR THE OPEN ACCESS FISHERIES

By

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ABSTRACT

Data collected by mandatory observers onboard vessels participating in six 1998-99 Bering Sea / Aleutian Islands open access crab fisheries are summarized. Estimates of CPUE and standard error of legal retained crabs for targeted species as well as bycatch of females, sublegal males, and nontarget species are provided. Sample pot locations are provided in separate charts for each fishery. Catch rates of targeted species are displayed by depth and soak time. CPUE for retained snow crabs (*Chionoecetes opilio*) was down 27% from the previous season; bycatch of female and sublegal male snow crab was down for the third straight year. The percentage of new-shelled male snow crabs decreased from the previous two seasons; females were nearly all old and very old-shelled individuals. CPUE for retained legal red king crabs (*Paralithodes camtschaticus*) in the Bristol Bay fishery was down slightly from the 1998 season, but bycatch of females and sublegal males was severely reduced. The number of recruit-sized males increased in 1999 samples, reversing a substantial decrease apparent in the 1998 season. Bycatch of red king crabs in the hair crab (*Erimacrus isenbeckii*) fishery was reduced by over 75% from the spike in the 1998 fishery. Data from the Aleutian Islands golden king crab (*Lithodes aequispina*) management area are summarized separately for the areas east and west of 174 W° longitude. Mean CL for male golden king crab in 1999 increased 4 mm over the 1998 fishery east of 174 W°; the CL mode was a post recruit size class in 1999. Approximately 75% of all golden king crabs caught in both the 1998 and 1999 fishery east of 174 W° and in the 1998/99 fishery west of 174 W°, were females and sublegal males. New-shell was the predominant shell class for both males and female golden king crabs through-out the Aleutian Islands.

INTRODUCTION

During the spring of 1988, the Alaska Board of Fisheries (BOF) mandated at-sea observer coverage for all vessels processing red king crabs *Paralithodes camtschaticus*, blue king crab *Paralithodes platypus*, golden king crab *Lithodes aequispina* and Tanner crabs *Chionoecetes bairdi* in state waters. In 1990 the BOF amended observer coverage regulations to include at-sea processors in the Bering Sea snow crab *C. opilio* fishery, and in 1995 observer requirements were adopted for vessels fishing king crabs in Aleutian Island waters. In addition to establishing fixed levels of observer coverage in these fisheries, the BOF has granted the Alaska Department of Fish and Game (ADF&G) authority to place observers on commercial fishing vessels participating in other shellfish fisheries in circumstances when such action constitutes the only practical means for gathering data or enforcing regulations. Observer coverage implemented in recent years under this provision has included all vessels fishing for hair crabs *Erimacrus isenbeckii*, scarlet king crabs *Lithodes couesi*, Paralomis *multispina* (a deep-water king crab species), grooved Tanner crabs *C. tanneri* and triangle Tanner crabs *C. angulatus*. Observer coverage has also been required on vessels participating in crab fishing seasons occurring under the recently implemented Community Development Quota (CDQ) Program. This report does not include data collected during the CDQ fisheries; however, that information is available from ADF&G Westward Region.

In some situations an observer's activities are prioritized to monitor and document vessel fishing activities for regulatory compliance, however, during most deployments their primary duties are to collect biological data and record vessel catch, bycatch and effort statistics. These data are used for a number of applications, including the development of models for estimating relative stock abundance, defining male and female crab size/age distributions, chronicling species reproductive cycles, quantifying levels of incidental bycatch, and producing preseason projections of fishery performance. Ultimately, the shellfish observer database provides a source of information crucial to the comprehensive management of Alaska's shellfish resources.

The database of biological and regulatory compliance information generated by observer deployments is maintained by ADF&G Westward Region staff. Archived information ranges from gear types fished, locations and soak times, to the species composition, size distribution and reproductive condition of the sampled catches.

Data compiled in this report were collected primarily within the 1999 calendar year for open access fisheries only. Due to the substantial volume of available statistics, the scope of the data presented has been narrowed to include the size and shell ages of targeted crabs, the documented incidence of illegally retained crabs, and general catch and effort information resulting from sampled pots. Since 1995, quantitative estimates of catch per pot pull and total catch of selected species and fisheries using harvest data have also been included. Additionally, a summary of all species encountered in pots sampled from each fishery has been included.

Any inconsistencies between previously published shellfish observer database reports and findings presented in this document are the result of updated summaries and interpretation of historical data.

METHODS

Comprehensive shellfish observer sample methods are outlined in the most recent edition of the ADF&G Shellfish Observer Field Manual (ADF&G 1998). Methods described in this report correspond only to the data presented and are not inclusive of all observer sampling duties.

Terms

For the purposes of this report, terms related to the discussion of sampled crabs are defined as follows:

<i>Carapace Length (CL) –</i>	the straight line distance from the posterior margin of the right eye orbit to the medial-posterior carapace margin; the biological size measurement of hair crabs and all species of king crabs
<i>Carapace Width (CW) –</i>	the mid-point straight line distance forming a right angle to a line midway between the eyes to the medial-posterior margin, not including the spines; the biological size measurement of snow crabs and all species of Tanner crab
<i>Legal Measurement –</i>	the mid-point straight line distance across the carapace of male crabs forming a right angle to a line midway between the eyes to the medial-posterior margin, including the spines
<i>Catch per unit effort (CPUE) -</i>	the value (or estimated value) representing the mean catch of crabs for a standardized unit of fishing effort; in this report CPUE represents the mean catch per pot
<i>Mature –</i>	male and female crabs that have attained a biological size where least 50% or more of a random sample of individuals are physiologically capable of mating
<i>Immature –</i>	male and female crabs that have not attained a biological size where least 50% or more of a random sample of individuals are physiologically capable of mating
<i>Soft-shell –</i>	exoskeletons that are newly molted (zero to two weeks old) and not yet hardened
<i>New pliable-shell –</i>	exoskeletons which are thin, and flexible, and not fully calcified (two to eight weeks old)
<i>New-shell –</i>	exoskeleton eight weeks to 12 months old (8 weeks to eighteen months for golden king crabs).

<i>Old-shell –</i>	exoskeleton more than 12 months and up to 24 months old (up to 36 months for golden king crabs).
<i>Very old-shell –</i>	exoskeleton more than 24 months old (more than 36 months old for golden king crabs)
<i>Uneyed eggs–</i>	early developmental stages of an egg with no distinguishing marking
<i>Eyed eggs –</i>	later developmental stages of an egg distinguished by dark eye spots
<i>Ovigerous –</i>	female crabs bearing eggs, either eyed or uneyed
<i>Mated/barren –</i>	female crabs not carrying eggs but displaying evidence of previous mating activity
<i>Non-mated/barren –</i>	female crabs not carrying eggs and not displaying evidence of previous mating activity
<i>Recruit –</i>	a new-shelled male crab of legal size in its first year of availability to the commercial fishery
<i>Post-recruit –</i>	a male crab of legal size and not classified as a recruit

Sampling Duties

During the 1999 Bering Sea/Aleutian Islands shellfish fisheries observers were deployed on catcher-processor vessels, floater-processor vessels and catcher-only vessels. Observers deployed on floater-processors had access only to pre-sorted, retained catches, while those placed on catcher-processor and catcher-only vessels were able to examine the contents of fished pots prior to sorting.

Floater-Processors

Principal sampling duties for observers onboard floater-processors (FPs) include monitoring deliveries from catcher-only vessels for regulation compliance regarding legal retention of crabs by species, size and sex. Sampling procedures consist of randomly selecting and examining up to 600 crabs from each vessel's catch. This sample type is referred to as a 'legal tally'. Additional data collected from deliveries to floater-processors include biological measurements of 100 crabs, randomly selected from each delivery, to determine carapace size distribution. This type of sampling is referred to as 'biological measurements of retained crabs'.

Catcher-Processors

Observers deployed on catcher-processors (CPs) conduct a legal tally and take average weights and biological measurements of retained crabs each day the vessel retains catch. They also

sample randomly selected pots for catch composition. This is referred to as 'bycatch sampling'. Methods for collecting bycatch samples include identifying and enumerating all species in the pot and recording legal and retention status, biological size, shell age, sex, and general health and vitality of all commercially important crabs. Female crabs in sampled pots are also evaluated for reproductive condition.

On occasions when catcher-only vessels make deliveries to catcher-processors, the observer samples the catch as if they were deployed on a floater-processor.

Catcher-Only Vessels

Data collection objectives for observers onboard catcher-only vessels are similar to those for catcher-processors, although bycatch sampling is usually the prioritized activity. Legal tally and biological measurements of the retained crabs are only conducted when the vessel delivers to a processing facility. If deliveries are made at-sea, the legal tally, biological measurements of retained crabs, and average weight samples are collected concurrently by the observer deployed on each vessel.

Daily sampling goals for observers on board catcher-processor and catcher-only vessels (e.g., quantity of fished pots examined and number of crabs measured) are dependent upon a number of variables anticipated during the fishing season. These variables include special data collection projects and the order of sampling priorities established by ADF&G. Fishery-specific sample goals are discussed in subsequent sections where appropriate.

Ad hoc research data collection projects were assigned to observers deployed on catcher-processors and catcher-only vessels during several of the 1999 fishing seasons. These projects included recording morphometric measurements of snow crabs for size-at-maturity and pot escape mechanism studies, collecting individual weights from non-retained hair crabs and red king crabs, tagging red king crabs in the Aleutian Islands, and sampling crabs in all observed fisheries for handling injuries and on-deck air exposure resulting from catch sorting. The results from these investigations have not been included in this report.

Estimation of CPUE and Total Fishery Catch

Estimates for CPUE and their standard errors were generated using weighted variance formulas for stratified sampling (Cochran 1977; Appendix A1). With this technique each vessel-day is considered a separate stratum. The weights reflect the relative importance of a vessel's daily sampling compared to all the days on which sampling occurred -- the greater the number of pots sampled on a given day, the greater the weight for that day. Variances were calculated for each vessel-day and then summed over all vessels and all days for the entire fishery.

As can be seen in the tables displaying the standard error estimates, there are several ways to calculate CPUE. Multiple estimates are included not to confuse the reader, but rather to provide a range of information and a basis for comparison. The 'sample' CPUE is generated from observer data, and is based solely on the sampled bycatch pots. This is the estimate which has been reported in past observer reports (Tracy 1994, 1995a, 1995b). It is calculated as total catch from sampled pots divided by total pots sampled. The 'weighted' CPUE uses the Cochran stratified

technique as described above and in Appendix A1. Weighted estimates and standard errors were calculated with Cochran's method for those crab species with a 'sample' CPUE greater than one crab per pot. The 'actual total fishery' (ATF) CPUE is based on fish ticket information as reported in the Regional Information Reports for commercial crab fisheries in the Bering Sea and Aleutian Island Management Areas (ADF&G Westward Region staff 1998). The 'actual observed fleet' (AOF or CI) CPUE is generated from confidential interviews with the vessel's captain, which are performed by onboard observers or dockside samplers. The ATF and CI CPUEs are generated for retained legal crabs only. Both provide information on total catch of retained crab, total pots pulled and fishing locations. Information from confidential interviews is recorded on a daily basis and is generally considered more accurate than information obtained from fish tickets (fish tickets reflect an entire trip between deliveries).

Estimated catch totals are derived by multiplying the CPUE estimates by the total number of pots pulled in the fishery. For those fisheries with 100% observer coverage the total pots pulled information is taken from confidential interviews. Otherwise the total pots pulled data is generated from fish ticket summaries.

When viewing CPUE and total catch estimates for both the directed catch and bycatch, the reader should note the precision and accuracy of the estimates. Precision is indicated by the standard errors. Accuracy is gauged by the comparability of the estimates for legal retained crabs obtained from observer data with those obtained from confidential interviews and fish tickets. The reader should also take note of whether the CPUE and total catch estimates provided here were based on data gathered by observers deployed on all participating fishing vessels or by observers deployed on catcher-processor vessels only. Application of CPUE estimates obtained from catcher-processor vessels to the entire fishing fleet assumes that catch rates for that distinct portion of the fleet are comparable to the remaining catcher-only vessel component of the fleet.

RESULTS

Bering Sea Snow Crab

During the 1999 fishing season observers were deployed on 10 catcher-processor and 11 floater-processor vessels. The bycatch sampling goal for observers on catcher-processors was four pots during each day of fishing activity. Due to the cold weather conditions typically associated with timing of the snow crab fishery, the large number of crabs per pot routinely taken, and the corresponding potential for excessive handling mortality attributable to sampling, catches in three of four pots were speciated and enumerated but not measured or otherwise assessed for ancillary characteristics. Concerns over cold weather exposure did not result in modification of sample protocols for legal tallies and biological measurements of retained crabs, which were collected both from catcher-processors and from deliveries to floater-processors. In addition, individual vessel daily catch and effort statistics and an average weight of retained crabs were obtained by observers deployed on both vessel types. A total of 1,507 pots selected for bycatch sampling accounted for less than one percent of the 899,043 pot lifts reported by vessel operators during the 67 day season (ADF&G Westward Region, *in press*). The location of pots sampled by observers during the 1999 Bering Sea snow crab fishery are displayed in Appendix B-1.

The number of measurements of retained snow crabs taken throughout the 1999 season by onboard observers and by ADF&G staff stationed at shoreside processing locations was approximately 147,000. A summary of these measurements and those taken at processors during the preceding three fishing seasons is provided in Table 1. At 110 mm the mean CW of crabs harvested in 1999 was similar to the 1998 season and increased slightly from the 1997 season, although since 1996 the mean CW of retained snow crabs has varied annually by less than 4 mm.

Measurements of CW were also taken from almost 57,000 male snow crabs (including legal-sized, retained and non-retained males and sublegal males) in bycatch samples. A 5 mm-interval histogram of these size measurements revealed a prominent mode between 102 and 112 mm. These results are similar to results of samples collected in 1998, which indicated an upward shift from the previous two seasons toward a greater frequency of legal males in the size distribution of crabs sampled in bycatch pots (Figure 1).

A much smaller number of female snow crabs ($n = 100$) observed in bycatch samples produced a mean CW of 61 mm. Even though this CW is 5 mm less than the female average in 1998 and 1997, this continues to indicate that, like males, most pot-caught females were mature crabs (Figure 2).

The stratified estimates of CPUE for targeted and non-targeted crabs encountered in the 1999 Bering Sea snow crab fishery are presented in Table 2. These estimates, derived from observer pot samples, are weighted by the daily total number of pots pulled by a vessel and may vary somewhat from unweighted estimates of CPUE (Figure 3). The estimate of 126.0 legal retained snow crabs represents a 25% decrease from the 1998 fishery season results, and is similar to estimates from the 1996 and 1997 snow crab fishery seasons. The estimate for legal retained crabs differs by 20% from both fish ticket and confidential interview CPUE estimates as is discussed in the 'Accuracy and Precision of CPUE Estimates' section (page 14). However, if the catch estimate for retained Tanner / opilio hybrids (20.9 crabs) is added to retained legal opilio the estimate varies by just 8% from the CI and fish ticket estimates. Precision of the estimate appears to be quite good as the standard error of the estimate accounts for less than 1% of the estimated mean CPUE. About 28% of the total catch of snow crabs was discarded as bycatch, most of which were legal crabs of less than 4 inches (102 mm) CW. Although the legal size for snow crabs is 3.1 inches (79 mm) CW, processing plants do not generally accept crabs less than 4 inches CW.

Catch rates of legal-sized retained male snow crabs dropped by 47 crabs per sampled pot compared to the 1998 fishery (Figure 3). With the exception of Tanner/snow crab hybrids, overall non-target crab catch rates decreased during the 1999 season, for the third consecutive season. Most notable was the decline in catches of legal-sized but non-retained male snow crabs, which dropped to a four year low CPUE of 45 (Figure 3). Total catches of all animals identified in sampled pots during the 1999 season are provided in Table 3.

Catch rates of snow crabs by soak hours from sampled pots varied between sex and size groups, although the relatively low female and sublegal male CPUEs remained the most static over time (Table 4). Catch rates of legal-sized retained male crabs were most variable. Line plots depicting snow crab CPUE by soak hours are provided in Figure 4.

Legal-sized retained and non-retained male snow crab CPUE declined at fishing depths greater than 80 fathom (fm) while sublegal male snow crab catch rates were static over the depth ranges at one or less per pot (Table 5). Eighty-seven percent of the pots sampled were at 80 fm or less. Line plots depicting snow crab CPUE by depth strata are provided in Figure 5.

Snow crab shell age statistics summarized from bycatch samples showed a decrease from the 1997 and 1998 seasons in percentage of new-shelled male crabs, and a corresponding increase between seasons in the abundance of old and very old-shelled males (Table 6). New-shelled snow crab females have been virtually absent or absent from samples taken from 1997 to 1999. In contrast, new-shelled females accounted for 36% of crabs sampled during the 1996 fishing season.

The numbers of female snow crabs carrying eggs in bycatch samples had a large increase from the 1998 season. This is also the highest percentage since 1995, although the sample size remained very small for 1999 at just 99 female crabs examined for reproductive characteristics. (Table 7).

Legal tallies conducted on catcher-processors and on catcher-only vessels delivering to floater-processors totaled over 400,000 crabs by the end of the 1999 season and comprised less than one percent of the cumulative reported harvest (Table 8). Just 0.2% of sampled crabs were deemed illegal due to size, sex or species, the same proportion of total landed crabs as during the 1998 season.

Bristol Bay Red King Crab

At-sea observers were deployed on nine catcher-processors and one floater-processor during the 1999 season. The bycatch sampling goal for observers on catcher-processors was three pots during each day of fishing activity. Whenever possible, catches in all pots sampled were speciated, counted, measured and otherwise assessed for ancillary characteristics. A total of 178 pots selected for bycatch sampling accounted for less than one percent of 146,997 pot lifts reported by vessel operators during the five day season (ADF&G Westward Region, *in press*). The location of pots sampled by observers during the 1999 Bristol Bay red king crab fishery are displayed in Appendix B-2.

Measurements of more than 17,500 red king crabs delivered to catcher-processors and floater-processor and shoreside processing locations produced a mean CL of 148 mm, which is 4 mm less than the mean for the 1998 season (Table 9). Retained crab CL was grouped tightly around four 5 mm intervals in 1999, with 79% of the samples falling between 136 and 155 mm.

Mean CL of male red king crabs from sampled pots was 140 mm, which was 4 mm greater than in 1998 (Figure 6). Recruit-sized crabs (137 to 154 mm CL), which comprised the predominant sample sizes during both the 1996 and 1997 seasons and had decreased substantially in 1998, appeared to increase in 1999, while recently matured (pre-recruit) males appeared to decrease.

Only 36 female red king crabs were observed in sampled pots, representing a dramatic decrease from the over 4,000 females sampled in 1998. The mean CL of 124 mm was 14 mm larger than the mean CL estimated from sample measurements taken during 1998 (Figure 7).

The stratified estimates of mean CPUE for selected targeted and non-targeted crabs in the 1999 Bristol Bay red king crab fishery are presented in Table 10. The estimate of 13.4 legal retained males per potlift represent a decrease of 16% from the 1998 season estimate. The estimate is close to estimates generated from fish tickets (12.3) and confidential interviews (12.1). This estimate is precise as the standard error of the estimates for legal retained males represents 6% or less of the mean CPUE estimate. The estimate for sublegal males is less precise, with the standard error accounting for about 10% of the mean. Bycatch of sublegal males decreased by 71%; bycatch of females was almost nonexistent, decreasing from a projected total fishery catch of nearly 4,000,000 in 1998 to 30,000 for the 1999 fishery season. About 32% of all red king crabs captured during the 1999 fishery were estimated to be discarded as bycatch.

The 1999 sampled fleet CPUE of legal red king crabs dropped by more than 4 crabs per pot from 1998 but was similar to the 1996 season (Figure 8). The catch rates of sublegal red king crab males decreased by 15 crabs per pot from the 1998 season and is lower than any of the preceding three seasons. Female crabs were nearly absent in sampled pots in 1999, which is similar to the 1996 and 1997 seasons, but dramatically less than the 28 crabs per pot in 1998 (Figure 8). CPUEs of all other commercially important crabs remained at the low bycatch levels seen in 1998. Catches of all animals encountered in sampled pots are provided in Table 11.

Soak periods for sampled pots ranged from 5 to 60 h and averaged 25 h. Catches of legal-sized red king crabs were greater as the hours soaked increased (Table 12). Sublegal male CPUEs showed a similar trend but the catches were generally low over the range of sample pot soak hours. CPUE of female red king crabs was negligible for all soak times (Figure 9).

The depths of sampled pots ranged from 29 to 50 fathoms. CPUE of legal-sized males ranged from five to eight crabs in depths less than 40 fathoms and increased to a CPUE of 32 crabs at 46 to 50 fathoms (Table 13). Female red king crab CPUE was one or less for all depths in sampled pots. CPUE of sublegal males remained at 8 crabs or less throughout all the ranges (Figure 10).

Similar to data results from the 1996, 1997 and 1998 seasons, shell age composition of red king crab males sampled in 1999 included 88% new shells (Table 14). The remainder of crabs in the sample were old-shelled and very old-shelled, in proportion similar to the 1998 fishery. As in 1996, 1997 and 1998 all female crabs sampled during each of the three seasons were characterized as new-shelled.

There was a very small sample of 36 female red king crabs assessed for reproductive conditions in 1999, the smallest sample size since the 1996 fishery. Eighty-six percent of the crabs sampled were carrying clutches of uneyed eggs, and there were no clutches of eyed eggs observed during the fishery (Table 15). Only one of the remaining five females showed signs of prior mating activity.

Legal tallies conducted on catcher-processors and on catch-only vessels delivering to floater-processors totaled approximately 40,000 crabs by the end of the 1999 season and accounted for 14% of the reported harvest from catcher-processors and floater-processors (Table 16). Less than one percent of sampled crabs were illegally harvested due to size, sex or species, similar to sample proportions calculated for the preceding three years.

Bering Sea Hair Crab

At-sea observers were deployed on all eight catcher-only vessels which participated in the 1999 season. The bycatch sampling goal for observers was 30 pots during each day of fishing activity. Catches in 15 of the 30 pots were only speciated and enumerated. A total of 2,274 pots selected for bycatch sampling accounted for 2.5% of the 92,333 pot lifts reported by vessel operators during the 37 day season (ADF&G Westward Region, *in press*). The location of pots sampled by observers during the 1999 Bering Sea hair crab fishery are displayed in Appendix B-3.

Approximately 990 measurements of retained hair crabs were taken throughout the season by observers onboard catcher-only vessels. A summary of these measurements and those taken during the preceding three years are provided in Table 17. Sample CL measurements were tightly grouped around the mean of 96 mm, with 87% ranging between 86 and 105 mm.

Measurements of CL were also taken from approximately 2,400 male hair crabs (including legal-sized, retained and non-retained males and sublegal males) in bycatch samples. A 5 mm-interval histogram of these measurements shows a predominant mode at 97 mm (Figure 11). The mean CL of 93 mm is 2 mm greater than the 1998 mean but identical to the 1997 mean. CL measurements from 122 female hair crabs in bycatch samples showed a predominant mode at 67 mm and a mean of 71 mm (Figure 12).

The stratified estimates of mean CPUE for hair crabs in the 1999 Bering Sea hair crab fishery are presented in Table 18. The estimate of mean CPUE for legal retained crabs exceeds that from fish tickets and confidential interviews by about a quarter crab per pot. The estimated mean CPUE for legal retained male hair crabs was very precise, as the standard error accounted for less than 2% of the estimated mean CPUE.

Catch rates of non-target crabs were similar to the 1996, 1997 and 1998 seasons, except for the bycatch of red king crab (all sizes and sexes) which had showed a dramatic increase in the 1998 season. (Figure 13). Bycatch of red king crabs was minimal in 1999, compared to the 1998 fishery when the projected total bycatch of red king crabs approached the estimated total catch of hair crabs. The catch rate of legal-sized retained male hair crabs in 1999 was identical to the 1998 season at 1.8 crabs per sampled pot. Total catches of all animals identified in sample pots are provided in Table 19.

Seventy percent of sampled pots were soaked between 13 and 36 h (Table 20). Catch rates of legal-sized retained male hair crabs remained at between one and two crabs per pot over all soak periods. Legal-sized non-retained and sublegal male and female hair crabs averaged less than one crab per sampled pot for all soak times. Line plots depicting hair crab CPUE by soak hours are provided in Figure 14.

Although no crabs were captured in the single sampled pot fished in less than 20 fathoms, catch rates of legal-sized retained male hair crabs were one or two crabs per pot over the rest of the depth ranges. Ninety-seven percent of the samples were taken from depths ranging between 21 to 40 fm (Table 21). The catch of legal-sized non-retained and sublegal male and female hair crabs averaged less than one crab per pot over all the depths sampled. Line plots depicting hair crab CPUE by depth strata are provided in Figure 15.

Hair crab shell age statistics summarized from bycatch samples show a slight decrease from the 1998 season in proportion of new-shelled male crabs with a corresponding increase in abundance of old and very old-shelled males (Table 22). The percentage of new-shelled female hair crabs was in excess of 90% as it has been for the previous five seasons. The increase in new-shelled females in the 1999 season was not statistically significant.

The proportion of female hair crabs carrying eggs was 17%, which is a major increase over the five percent for the 1997 and 1998 fisheries, but similar to the sample proportions from the 1994 and 1995 fisheries. Of the 101 females without clutches, only seven (6.9%) showed signs of prior mating (Table 23).

Legal tallies conducted on catcher-only vessels totaled over 13,000 crabs by the end of the 1999 season and comprised over nine percent of the cumulative reported harvest (Table 24). Just 0.2% of sampled crabs were deemed illegal due to size, sex or species, a smaller proportion of the total landed crabs than any recorded during the preceding five years.

Aleutian Islands Golden King Crab

In March 1996, the BOF established the Aleutian Islands king crab registration area by combining two existing areas, Dutch Harbor and Adak. The BOF established September 1 as the opening date for the new area, and closure would be by emergency order instead of regulatory date. In addition the BOF directed the department to manage the golden king crab stocks of the Aleutians Islands east and west of 174° W longitude as two distinct stocks (ADF&G Westward Region, 1999). In the past this report series combined the data collected east and west of 174° W longitude into one section. The data included in this report are separated by area (east and west of 174° W longitude) and includes the 1998/1999 season and the eastern portion of the 1999/2000 fishery. Legal tally sampling data from the Aleutian fishery will remain combined for the entire registration area until changes can be made to the database.

Aleutian Islands East of 174° W Longitude

1998. The 1998 Aleutian Islands golden king crab fishery east of 174° W longitude began September 1, 1998 and concluded November 7, 1998. Regulations stipulate 100% observer coverage in this fishery. During the 1998 fishing season observers were deployed on one catcher-processor and 13 catcher-only vessels. The bycatch sampling goal for observers on catcher-only vessels varied from 6 to 10 pots per day fished depending upon the type of pots fished and the number of animals encountered. The bycatch sampling goal for observers on catcher-processor vessels was four pots for each day fished. Catches in all pots were speciated, enumerated, measured and assessed for other ancillary characteristics. A total of 3,616 pots selected for bycatch sampling accounted for four percent of 83,378 pot lifts reported by vessel operators during the 68 day season (ADF&G Westward Region, in press). The location of pots sampled by observers during the 1998 Aleutian Islands golden king crab fishery east of 174° W are displayed in Appendix B-4.

A total of more than 8,000 measurements of retained golden king crabs were taken throughout the season by onboard observers and by ADF&G staff stationed at shoreside processing

locations. A summary of these measurements and those taken during the prior two fishing seasons are provided in Table 25. At 148 mm, the mean CL of crabs harvested in 1998 is within 1 mm of the previous two seasons.

Measurements of CL were also taken from more than 91,000 male golden king crabs (including legal-sized, retained and non-retained males and sublegal males) in bycatch samples. The results of a 5 mm-interval histogram of these measurements are similar to samples collected in the 1996 and 1997 season. The mean CL of 128 mm is only 1 mm less than that of the previous two fishing seasons (Figure 16). Carapace length measurements from more than 44,000 female golden king crabs showed a mean CL of 114 mm, which was 3 mm less than the mean CL from the 1997 season and the same as the 1996 mean (Figure 17).

The stratified estimates of mean CPUE for golden king are presented in Table 26. The estimate of mean CPUE for legal retained crabs exceeds that from fish tickets and confidential interviews by less than one crab per pot. Estimated mean CPUE for legal retained male golden king crabs was very precise, as the standard error accounted for just 3% of the estimated mean CPUE. The bycatch of female and undersized male golden king crabs was substantial; three out of every four golden king crabs caught had to be returned to the sea.

Non-targeted crab catch rates from bycatch samples were highest for sublegal male golden king crab at a CPUE of 16 crabs (Figure 18). Total catches of all animals identified in sample pots are provided in Table 27.

Catch rates of legal-sized male golden king crabs increased as soak time increased up to 312 h while the catch rates of sublegal males and females were more variable (Table 28). The mean soak time was 103 h and less than one percent of the sampled pots were soaked longer than 312 h. Line plots depicting golden king crab CPUE by soak hours are provided in Figure 19.

Catch rates of legal-sized male golden king crabs were fairly consistent over depth ranges. Sixty-two percent of the samples were taken from depths ranging between 76 and 175 fm (Table 29). Both sublegal male and female golden king crab CPUE increased with depth, peaking at 57 and 51 crabs, respectively, between 351 and 375 fm. Line plots depicting golden king crab CPUE by depth strata are provided in Figure 20.

Golden king crab shell age statistics summarized from bycatch samples that, comparable to 1996 and 1997, new-shelled female crabs comprised over 95% of the total females. The percentage of new-shelled golden king crab males was similar to the previous season at 96.7% of the sample. The percentage of new-shelled golden king crabs shows little annual variation and is consistent between sexes.

Thirty-nine percent of the golden king crab females that were examined for reproductive conditions in 1998 carried eggs compared to the 45% that carried clutches in 1997. Of the nearly 27,000 females without clutches, 10,600 (39.2%) showed signs of prior mating (Table 31).

Legal tallies conducted on catcher-processors and on deliveries to processors from catcher-only vessels totaled over 140,000 crabs by the end of the 1998/1999 season and comprised 12% of the cumulative reported harvest. Just 0.5% of sampled crabs were deemed illegal due to size, sex or species, a proportion similar to the previous season.

1999. The 1999 Aleutian Islands golden king crab fishery east of 174° W longitude began September 1, 1999 and concluded October 25, 1999. Regulations stipulate 100% observer coverage in this fishery. During the 1999 fishing season observers were deployed on one catcher-processor and 14 catcher-only vessels. The bycatch sampling goal for observers on catcher-only vessels varied from 6 to 10 pots per day fished depending upon the type of pots fished and the number of animals encountered. The bycatch sampling goal for observers on catcher-processor vessels was four pots for each day fished. Catches in all pots were speciated, enumerated, measured and otherwise assessed for ancillary characteristics. A total of 3,851 pots selected for bycatch sampling accounted for five percent of 79,129 pot lifts reported by vessel operators during the 55 day season (ADF&G Westward Region, in press). The location of pots sampled by observers during the 1999 Aleutian Islands golden king crab fishery east of 174° W longitude are displayed in Appendix B-5.

A total of more than 6,000 measurements of retained golden king crabs were taken throughout the season by onboard observers and by ADF&G staff stationed at shoreside processing locations. A summary of these measurements and those taken during the three previous fishing seasons are provided in Table 25. At 147 mm the mean CL of crabs harvested in 1999 is 1 mm less than the 1998 season.

Measurements of CL were also taken from more than 79,000 male golden king crabs (including legal-sized, retained and non-retained males and sublegal males) in bycatch samples. These measurements are displayed in a 5 mm-interval histogram Figure 16. The mean CL of 132 mm is 4 mm greater than that from the 1998 fishing season. Measurements from approximately 36,700 female golden king crabs showed a mean CL of 116 mm, which is 2 mm greater than the mean CL from the 1998 season (Figure 17).

The stratified estimates of mean CPUE for golden king crabs are presented in Table 33. The estimate of mean CPUE for legal retained crabs exceeds that from fish tickets and confidential interviews by less than one-half crab per pot. Estimated mean CPUE for legal retained male golden king crabs was very precise, as the standard error accounted for just 1.5% of the estimated mean CPUE. Estimates for females and sublegal males were equally as precise. Both the bycatch of females and sublegal males exceeded the catch of legal retained males; about three of every four golden king crabs caught had to be returned to the sea as bycatch. Non-targeted crab catch rates from bycatch samples were highest for sublegal golden king crab at a CPUE of 11 crabs, this was down from the 16 sublegal crabs per sampled pot during the 1998 fishery (Figure 18). Although CPUE of sublegal males again exceeded that for legal males in 1999, CPUE of legal and sublegal crabs were more comparable to each other in 1999 than in preceding years. Total catches of all animals identified in sample pots are provided in Table 34.

Sixty-seven percent of the sampled pots were soaked between 49 and 120 h, while less than one percent of the pots had soak time greater than 264 h (Table 35). Catch rates of golden king crabs were variable over soak time regardless of sex or size. Line plots depicting golden king crab CPUE by soak hours are provided in Figure 21. Increases in soak time were generally associated with increases in CPUE for all sex-size classes of golden king crabs.

Catch rates of male golden king crabs were variable over the depth ranges sampled. Sixty-eight percent of the samples were taken from depths ranging between 101 and 200 fm (Table 36). Female golden king crab CPUE increased with depth, peaking at a CPUE of 59 crabs between

351 and 375 fm. Sublegal male CPUE increased with depth in waters deeper than 125 fm. Line plots depicting golden king crab CPUE by depth strata are provided in Figure 22.

Male and female golden king crab shell age statistics summarized from bycatch samples were consistent with sample results from the 1998 season, with 96 and 98 percent of males and females, respectively, assessed as new-shelled (Table 30).

Forty-three percent of female golden king crabs carried eggs in 1999, a slight increase from 1998 and is similar to the 1996 and 1997 seasons (Table 31). Of the nearly 21,000 females without clutches, 8,400 (40%) showed signs of prior mating.

Aleutian Islands West of 174° W Longitude

The 1998/1999 Aleutian Islands golden king crab fishery west of 174° W longitude began September 1, 1998 and concluded August 31, 1999; fishing activity occurred during every month of the season. Observer requirements stipulate 100% coverage in this fishery. During the 1998/1999 fishing season west of 174° W observers were deployed on one catcher-processor and two catcher-only vessels. The bycatch sampling goal for observers on catcher-only vessels varied from 6 to 10 pots per day fished depending on the type of pots fished and number of animals encountered. Catches in all pots were speciated, enumerated, measured and assessed for other ancillary characteristics. A total of 1,351 pots selected for bycatch sampling accounted for four percent of 35,920 pot lifts reported by vessel operators during the season (ADF&G Westward Region, *in press*). The location of pots sampled by observers during the 1998/1999 Aleutian Islands golden king crab fishery are displayed in Appendix B-6.

A total of more than 20,000 measurements of retained golden king crabs were taken throughout the season by onboard observers and by ADF&G staff stationed at shoreside processing locations. A summary of these measurements and those taken during the 1996/1997 and 1997/1998 fishing seasons are provided in Table 37. At 146 mm, the mean CL of crabs harvested in 1998/1999 is within 1 mm of the 1996/1997 and 1997/1998 seasons.

Measurements of CL were also taken from more than 36,000 male golden king crabs (including legal-sized, retained and non-retained males and sublegal males) in bycatch samples. These measurements are displayed in a 5 mm-interval histogram and are similar to samples collected in the 1996/1997 and 1997/1998 seasons (Figure 23). The mean CL of 131 mm is only 1 mm less than the previous fishing season and 1 mm greater than the 1996/1997 season. Measurements from more than 22,000 female golden king crabs showed a mean CL of 124 mm which was 3 mm less than the mean CL from the 1997/1998 season and 2 mm less than the 1996/1997 season (Figure 24).

The stratified estimates of mean CPUE for golden king are presented in Table 38. The estimate of mean CPUE for legal retained crabs exceeds that from fish tickets and confidential interviews by less than one crab per pot. Estimated mean CPUE for legal retained male golden king crabs was very precise, as the standard error accounted for less than 3% of the estimated mean CPUE. Estimates for females and sublegal males were only slightly less precise. Both the bycatch of females and sublegal males exceeded the catch of legal retained males; about three of every four golden king crabs caught had to be returned to the sea as bycatch.

The 1998/1999 sampled fleet CPUE of legal golden king crabs was nearly double the 1996/1997 estimate and more than four crabs per pot greater than the sampled fleet CPUE calculated from 1997/1998 data (Figure 25). Non-target golden king crab catch rates also increased notably between the 1997/1998 and 1998/1999 seasons. Catch rates of undersized males rose by almost 100% from 8.1 to 16 crabs per pot. Female crabs were caught at a rate of 16.5 crabs per pot in 1998/1999 compared to the 1997/1998 rate of 10.5 crabs per pot, an increase of 57%. Overall the CPUE proportion of non-target and undersize crab to legal male crabs has remained similar during the 1996/1997, 1997/1998, and 1998/1999 seasons. A total of all animals identified in sample pots are provided in Table 39.

Highest CPUE of legal-sized crabs was observed for soak periods ranging from 193 to 432 h (Table 40). Eighty-seven percent of pots sampled soaked between 97 and 384 h. Soak periods overall ranged from 1 to 960 h. Catch rates of female, legal-sized and sublegal golden king crabs were highest at soak times between 97 and 432 hours, but was not otherwise clearly correlated with increases in soak time. Line plots depicting golden king crab CPUE by soak hours are provided in Figure 26.

Catch rates of legal-sized, sublegal male and female golden king crabs tended to increase as depth increased (Table 41). Catch rates of females were the highest between 201 fm and 325 fm, with CPUEs of 23 to 32 caught. Eighty percent of the pots sampled were fished between 126 fm and 250 fm. Line plots depicting golden king crab CPUE by depth strata are provided in Figure 27.

Golden king crab shell age statistics are summarized from bycatch samples in Table 42. New-shelled males remained at > 95% of sampled males in the 1998/1999 season, as in preceding seasons. The percentage of new-shelled golden king crab females remained the same as the previous season at 99% of the sample. As in the fishery to the east of 174° W longitude, the percentage of new-shelled crabs was fairly consistent between sexes.

The proportion of female golden king crabs that carried eggs remained unchanged at approximately half the population during the last three seasons. Of the more than 11,000 females without clutches in 1998/1999, 3,600 (32%) showed signs of prior mating. This compares to 40% the previous season and 42% in 1996/1997 (Table 43).

Accuracy and Precision of Catch Per Unit Effort (CPUE) Estimates

In using CPUE estimates based on observer data it is important to have some assessment of their reliability in estimating the catch rates for observed vessels and, especially, for all vessels participating in a fishery. Although the observer data are the only source of information on bycatch rates in the fisheries presented in this report, confidential interviews with the operators of observed vessels and fish tickets provide data for independent estimates of the CPUE of retained legal crabs. We can gain some understanding of the reliability of the CPUE estimates computed from observer sample data by comparing the retained legal CPUE estimates computed from observer data with those computed from confidential interview/weekly trip summaries and fish ticket data. Weekly trip summaries are completed by operators of catcher processors; confidential interviews are conducted by both observers deployed on fishing vessels and by dockside samplers. The information collected is essentially identical on both forms.

The confidential interview / weekly trip summary data provide estimates of retained legal CPUE from both observed and unobserved vessels participating in a fishery. In this discussion we will refer to the retained legal CPUE estimated from confidential interview and weekly trip summaries data as the "Confidential Interview CPUE" (CI CPUE). Fish ticket data from all landings of all vessels participating in a fishery provide an independent estimate of the total fishery CPUE of retained legal crabs for a fishery in which observers were required only on catcher-processor vessels (CPs). We will refer to the CPUE of retained legal crabs estimated from the fish ticket data for all fishery landings as the "Actual Total Fishery CPUE" (ATF CPUE).

CPUE estimates computed from observer bycatch samples for retained legal crabs are within 11% and/or less than one crab per pot of the CI CPUE for all fisheries in which crab observers were deployed except for the Bering Sea snow crab fishery (Table 44). The close agreement between the observer-based and CI CPUE estimates for retained legal crab, in each of those five Bering Sea/Aleutian Islands crab fisheries, indicates that observer bycatch sample data provide highly reliable estimates of CPUE for the observed portion of the fleet. The close agreement between those two CPUE estimates also indicates that observer data provide reliable CPUE estimates for the entire Aleutian Islands golden king crab and the Bering Sea hair crab fishery because observer coverage was 100% in each of those fisheries.

Since 1995 when stratified estimates of CPUE were first estimated from shellfish observer bycatch data, the snow crab fishery has been the most problematic in terms of estimates agreeing with fish ticket and confidential interview data. The harvest of snow crabs is by far the largest of all shellfish fisheries prosecuted in the Bering Sea and Aleutian Islands, in terms of total crabs, pounds and average catch per potlift. This fishery is characterized by the highest total pots pulled of any Westward Region shellfish fishery. The 1,507 sampled pots from CPs account for less than 0.2% of the nearly 900,000 pots pulled.

CPUE estimates (126.0 crabs) computed from observer data for retained legal crabs in the 1999 Bering Sea snow crab fishery differed from both the CI and ATF CPUEs by about 33 fewer crabs per pot (a 21% discrepancy), indicating lower reliability of observer bycatch sample data in providing catch rate estimates for the observed fleet in that fishery (Table 2). A closer look at the performance of the 10 catcher-processors on which observers were deployed show that only one vessel yielded a CPUE estimate (181.9 crabs) greater than either the fish ticket (159.4 crabs) or confidential interview (159.1 crabs) estimate, indicating that the difference in estimates can not be attributed to the relatively poor performance of a few observed vessels. The difference in how Tanner/snow crab hybrids are counted, however, can explain most of the discrepancy between observer data-based estimates and fish ticket estimates. By regulation, in the Bering Sea any Tanner crab '...with both eyes completely red in color and the margin of the upper lip (labrum) notched at two points with angular V-shaped cuts forming an "M" shape is considered to be a *C. bairdi* Tanner crab' (5 ACC 35.521(a)). Also by regulation any '...hybrid Tanner crab that does not conform to that description is considered to be a *C. opilio* (snow) Tanner crab' (5 ACC 35.521(c)). Observers are instructed to record all hybrids separately from pure snow crabs, but crew members count all hybrids that are legally classified as *C. opilio* as snow crabs. The stratified estimates of legally retained snow crab males added with legally retained hybrids gives an estimate of 140.9 crabs per pot. This estimate differs from the CIF by 7.7% and from fish tickets by 7.8%, both within the range of accuracy for other observed fisheries.

Comparison of CPUE estimates based on observer bycatch sample data for retained legal crabs with the CI and ATF CPUE (i.e., from fish tickets) in all the other fisheries with partial observer coverage indicates that partial observer coverage provided adequate data for estimation of mean CPUE for those fisheries. Although the observer-based estimate for retained legal males in the Korean hair crab fishery differed by 12.5% from the confidential interview, in terms of harvest the difference was only 0.1 crab per pot. The three Aleutian Islands golden king crab seasons discussed in this report realized the best agreement between estimates, a fact that can largely be attributed to the 100% observer coverage required for vessels harvesting golden king crabs in the Aleutians.

The 'stratified' observer-based CPUE estimator used in this report is different from the 'sample' observer-based CPUE estimate used in past Mandatory Shellfish Observer Database Summaries (e.g., Tracy 1994, 1995a,b). Although the stratified estimation method can provide more accurate and precise estimates, the stratified and sample CPUE estimates are generally very close to each other. Therefore the stratified estimates presented here are comparable to those CPUE estimates included in previous observer data summaries. The value of using the stratified CPUE estimates is that the estimation method allows for computation of the standard errors of the CPUE estimates.

The standard errors provided in this report give a measure of the precision or repeatability of the CPUE estimates. Generally, the stratified CPUE estimates appear to be precise, as reflected in the relatively small standard errors. We did not compute confidence intervals for the CPUE estimates as the sample size within each stratum (vessel-day) was not large enough to assume an asymptotic normal distribution. However, bootstrap simulation of observer data collected in the 1995 Bering Sea and Aleutian Islands crab fisheries suggests that the stratified CPUE estimates plus or minus two standard errors was adequate to characterize the true CPUE of the targeted species (Byrne and Pengilly 1998).

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Table 1. Carapace size frequency distributions from biological measurements of retained snow crabs sampled during the 1996-1999 Bering Sea snow crab fisheries.

Width (mm)	1996		1997		1998		1999	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
86-90	1,991	2.0	897	0.7	419	0.2	390	0.3
91-95	5,058	5.2	3,848	3.0	1,903	1.1	1,848	1.3
96-100	12,073	12.4	16,168	12.6	10,366	6.0	9,500	6.4
101-105	19,803	20.4	34,763	27.2	31,849	18.5	27,368	18.6
106-110	20,572	21.2	32,027	25.1	43,576	25.2	37,537	25.5
111-115	17,018	17.5	21,544	16.9	40,080	23.2	34,976	23.8
116-120	11,317	11.7	11,487	9.0	26,167	15.2	22,695	15.4
121-125	5,620	5.8	4,905	3.8	12,363	7.2	9,522	6.5
126-130	1,822	1.9	1,459	1.1	4,499	2.6	2,653	1.8
131-135	400	0.4	281	0.2	1,038	0.6	479	0.3
Totals	95,674	98.6	127,379	99.6	172,260	99.7	146,968	99.8
	Mean width = 107.5 mm		Mean width = 107.3 mm		Mean width = 110.6 mm		Mean width = 110.3 mm	

Table 2. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on 10 catcher-processors during the 1999 Bering Sea snow crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 1,507 sampled pot lifts.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
<u>snow crab</u>			
legal retained males	186,875	126.0 (0.48) ^b	113,280,000 ^c
legal not retained males	68,074	46.8 (0.17)	42,075,000
sublegal males	1,529	1.0 (0.01)	900,000
females	160	0.1 ^d	95,000
<u>Tanner crab</u>			
legal not retained	63	<0.1 ^d	37,600
sublegal males	2,206	1.4 (0.02)	1,260,000
females	693	0.6 ^d	415,000
<u>Tanner/snow hybrid</u>			
legal retained males	32,295	20.9 (0.20)	18,800,000
legal not retained males	9,928	6.6 (0.15)	5,930,000
sublegal males	222	0.1 ^d	132,000
females	78	<0.1 ^d	46,500

^a Estimated CPUE multiplied by 899,043 total pot lifts (ADF&G, Westward Region staff 2000) during fishery.

^b Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 159.2 for observed vessels; actual total fishery CPUE of retained legal crabs was 159.4 for all vessels (ADF&G, Westward Region staff 2000).

^c Actual catch of retained legal crabs for the fishery was 143,296,568 (ADF&G, Westward Region staff 2000).

^d CPUE computed as total pot sample catch divided by 1,507 pots sampled; standard errors of estimates were not computed.

Table 3. Total pot contents from 1,507 bycatch samples taken on 10 catcher-processors during the 1999 Bering Sea snow crab fishery.

Species		Total number observed
Snow crab	Legal Male	254,949
	Sublegal	1,529
	Female	160
Tanner/snow crab hybrid	Legal Male	42,223
	Sublegal	222
	Female	78
Tanner crab	Legal Male	63
	Sublegal	2,206
	Female	693
Blue king crab	Legal Male	3
	Sublegal	16
	Female	5
Red king crab	Legal Male	1
	Sublegal	0
	Female	22
Golden king crab	Legal Male	0
	Sublegal	1
	Female	0
Hair crab	Legal Male	37
	Sublegal	2
	Female	0
Snail unidentified		3,558
Starfish unidentified		944
Pacific cod		887
Sculpin unidentified		461
Hermit crab unidentified		406
Yellowfin sole		135
Flatfish unidentified		101
Lyre crab		43
Octopus		41
Walleye pollock		32
Bigmouth sculpin		24
Pacific halibut		13
Sea urchin unidentified		7
Rock sole		7
Sea anemone		6
Skate unidentified		5
Snailfish unidentified		4

-Continued-

Table 3. (page 2 of 2)

Species	Total number observed
Flathead sole	4
Rockfish unidentified	3
Great sculpin	3
Yellow Irish lord	3
Brittle Star	2
Tunicate unidentified	2
Arrowtooth flounder	2
Pribilof neptune (snail)	1
Hairy triton	1
Scaled crab	1
Prowfish	1
Decorator Crab	1
Neptunea spp.	1
Squid unidentified	1

Table 4. Estimated CPUE of snow crabs by soak hours from 1,507 bycatch samples taken on 10 catcher-processors during the 1999 Bering Sea snow crab fishery.

Soak Hours	Pots Sampled		Catch Per Sampled Pot				Total Crabs
	Number	Percent	Legal Retained	Legal Not Retained	Sublegal	Female	
1-24	293	19.4	87	49	1	<1	137
25-48	811	53.8	133	45	1	<1	180
49-72	209	13.9	126	45	1	<1	172
73-96	67	4.4	118	34	1	0	152
97-120	44	2.9	171	50	1	0	222
121-144	41	2.7	142	30	<1	0	173
145-168	19	1.3	124	58	1	0	183
169-192	7	0.5	130	73	1	0	205
193-216	5	0.3	31	5	0	0	36
217-240	1	0.1	203	13	1	0	217
241-264	2	0.1	101	26	0	0	127
265-288	0	0.0	0	0	0	0	0
289-312	0	0.0	0	0	0	0	0
313-336	0	0.0	0	0	0	0	0
337-360	0	0.0	0	0	0	0	0
361-384	0	0.0	0	0	0	0	0
385-408	1	0.1	0	0	0	0	0
409-432	3	0.2	241	38	2	<1	281
433-456	2	0.1	296	34	4	1	333
457-480	2	0.1	293	43	1	0	337
Mean Soak: 48 hours	Overall CPUE:		124	45	1	<1	170

Table 5. Estimated CPUE of snow crabs by depth from 1,507 bycatch samples taken on 10 catcher-processors during the 1999 Bering Sea snow crab fishery.

Fathoms	Pots Sampled		Catch Per Sampled Pot				Total Crabs
	Number	Percent	Legal Retained	Legal Not Retained	Sublegal	Female	
31-40	64	4.2	77	12	<1	0	90
41-50	176	11.7	117	22	1	<1	140
51-60	206	13.7	104	27	1	<1	133
61-70	322	21.4	131	57	1	<1	190
71-80	539	35.8	142	62	1	<1	206
81-90	114	7.6	101	32	<1	0	133
91-100	43	2.9	107	30	<1	0	137
101-110	22	1.5	89	16	<1	0	105
111-120	14	0.9	130	25	<1	0	155
121-130	3	0.2	166	75	0	0	241
131-140	3	0.2	119	3	0	0	122
Mean Depth: 68 Fathoms	Overall CPUE:		124	45	1	<1	170

Table 6. Shell ages of male and female snow crabs in bycatch samples taken on catcher-processors during the 1994-1999 Bering Sea snow crab fisheries.

Year/ Sex	Sample Size	Shell Age Classes							
		Soft	%Total	New	%Total	Old	%Total	Very Old	%Total
1994									
Males	167,447	4	< 0.1	156,555	93.5	9,942	5.9	946	0.6
Females	1,273	0	0	62	4.9	929	73.0	282	22.2
1995									
Males	77,302	2	< 0.1	68,596	88.7	8,083	10.5	621	0.8
Females	539	0	0	74	13.7	328	60.9	137	25.4
1996									
Males	76,028	46	0	54,249	71.4	18,163	23.9	3570	4.7
Females	136	0	0	49	36.0	46	33.8	41	30.1
1997									
Males	128,429	1	< 0.1	125,086	97.4	3,123	2.4	219	0.2
Females	787	0	0	2	0.3	466	59.2	319	40.5
1998									
Males	120,472	3	< 0.1	111,909	92.9	7,881	6.5	679	0.6
Females	89	0	0	0	0.0	53	59.6	36	40.4
1999									
Males	56,973	1	< 0.1	51,038	89.6	4,734	8.3	1,191	2.1
Females	100	0	0	2	2.0	16	16.0	82	82.0

Table 7. Reproductive condition of female snow crabs in bycatch samples taken on catcher-processors during the 1994-1999 Bering Sea snow crab fisheries.

Year	Crabs Sampled	Eyed Eggs		Uneyed Eggs		Barren, Mated		Barren, Non-mated	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1994	1,249	800	64.1	60	4.8	116	9.3	273	21.9
1995	423	340	80.4	53	12.5	26	6.1	4	0.9
1996	136	81	59.6	5	3.7	22	16.2	28	20.6
1997	789	323	40.9	5	0.6	240	30.4	221	28.0
1998	90	19	21.1	8	8.9	34	37.8	29	32.2
1999	99	68	68.7	5	5.1	22	22.2	4	4.0

Table 8. Results of legal tally samples taken on catcher-processors and floater-processors during the 1994-1999 Bering Sea snow crab fisheries. Harvest figures include only those catches from catcher-processors and vessels that delivered to floater-processors.

Year	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested ^a	Estimated Number Illegal Crabs	Percent Harvest Sampled
		Number	Percent	Number	Percent					
1994	868,705	972	0.1	188	< 0.1	3,993	0.6	79,356,180	470,726	1.1
1995	513,847	1,341	0.3	121	< 0.1	2,527	0.8	37,817,595	293,578	1.4
1996	459,978	1,027	0.2	52	< 0.1	1,318	0.5	32,990,601	171,918	1.4
1997	603,829	526	0.1	116	< 0.1	1,464	0.3	61,061,226	212,966	1.0
1998	795,708	461	0.1	21	< 0.1	1,404	0.2	92,011,193	218,086	0.9
1999	400,814	126	< 0.1	3	< 0.1	779	0.2	68,688,688	155,607	0.6

^a ADF&G Westward region staff 2000.

Table 9. Carapace size frequency distributions from biological measurements of retained red king crabs sampled during the 1996-1999 Bristol Bay red king crab fisheries.

Length (mm)	1996		1997		1998		1999	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
131-135	201	2.3	407	2.5	614	3.8	487	2.8
136-140	842	9.5	1,732	10.7	2,263	14.0	3,039	17.2
141-145	1,302	14.6	2,443	15.1	2,468	15.3	4,511	25.5
146-150	1,511	17.0	2,613	16.2	2,391	14.8	3,784	21.4
151-155	1,572	17.7	2,738	17.0	2,300	14.3	2,662	15.1
156-160	1,427	16.0	2,511	15.6	2,238	13.9	1,492	8.4
161-165	1,049	11.8	1,839	11.4	1,809	11.2	829	4.7
166-170	591	6.6	1,169	7.2	1,210	7.5	489	2.8
171-175	266	3.0	474	2.9	560	3.5	230	1.3
176-180	90	1.0	158	1.0	178	1.1	102	0.6
Totals	8,851	99.5	16,084	97.1	16,031	95.5	17,625	97.0
	Mean Length =	152.6 mm	Mean Length =	152.5 mm	Mean Length =	151.8 mm	Mean Length =	148.0 mm

Table 10. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on 9 catcher-processors during the 1999 Bristol Bay red king crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 178 sampled pot lifts.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
<u>red king crab</u>			
legal retained males	2,162	13.4 (0.83) ^b	2,000,000 ^c
legal not retained males	3	<0.1 ^d	2,500
sublegal males	1,093	6.1 (0.60)	900,000
females	36	0.2 ^d	30,000

^a Estimated CPUE multiplied by 146,997 total pot lifts (ADF&G, Westward Region staff 2000) during fishery.

^b Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 12.1; actual total fishery CPUE of retained legal crabs was 12.3 for all vessels (ADF&G, Westward Region staff 2000).

^c Actual catch of retained legal crabs for the fishery was 1,812,345 (ADF&G, Westward Region staff 2000).

^d CPUE computed as total pot sample catch divided by 178 pots sampled; standard errors of estimates were not computed.

Table 11. Total pot contents from 178 bycatch samples taken on 9 catcher-processors during the 1999 Bristol Bay red king crab fishery.

Species		Total number observed
Red king crab	Legal Male	2,165
	Sublegal	1,093
	Female	36
Tanner crab	Legal Male	41
	Sublegal	90
	Female	10
Snow crab	Legal Male	83
	Sublegal	20
	Female	1
Tanner/snow crab hybrid	Legal Male	4
	Sublegal	2
	Female	0
Hair crab	Legal Male	4
	Sublegal	0
	Female	1
Starfish unidentified		143
Pacific cod		130
Yellowfin sole		77
Sculpin unidentified		17
Snail unidentified		16
Pacific halibut		1
Lyre crab		1
Octopus		1

Table 12. Estimated CPUE of red king crabs by soak hours from 178 bycatch samples taken on 9 catcher-processors during the 1999 Bristol Bay red king crab fishery.

Soak Hours	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
1-12	7	3.9	6	2	<1	8
13-24	97	54.5	9	5	<1	15
25-36	66	37.1	14	8	<1	22
37-48	7	3.9	27	8	<1	36
49-60	1	0.6	105	9	0	114
Mean Soak: 25 hours	Overall CPUE:		12	6	<1	18

Table 13. Estimated CPUE of red king crabs by depth from 178 bycatch samples taken on 9 catcher-processors during the 1999 Bristol Bay red king crab fishery.

Fathoms	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
26-30	10	5.6	8	8	<1	16
31-35	34	19.1	8	6	<1	14
36-40	63	35.4	5	4	<1	10
41-45	45	25.3	14	8	1	23
46-50	26	14.6	32	7	<1	39
Mean Depth: 39 Fathoms	Overall CPUE:		12	6	<1	19

Table 14. Shell ages of male and female red king crabs in bycatch samples taken on catcher-processors during the 1996-1999 Bristol Bay red king crab fisheries.

Year/ Sex	Crabs Sampled	Shell Age Classes							
		Soft	%Total	New	%Total	Old	%Total	Very Old	%Total
1996									
Males	642	0	0.0	539	84.0	97	15.1	6	0.9
Females	11	0	0.0	11	100.0	0	0.0	0	0.0
1997									
Males	1,787	0	0.0	1,580	88.4	190	10.6	17	1.0
Females	68	0	0.0	68	100.0	0	0.0	0	0.0
1998									
Males	5,556	1	<0.1	4,849	87.3	578	10.4	128	2.3
Females	4,091	0	0.0	4,091	100.0	0	0.0	0	0.0
1999									
Males	2,768	0	0.0	2,444	88.3	259	9.4	62	2.2
Females	36	0	0.0	36	100.0	0	0.0	0	0.0

Table 15. Reproductive condition of female red king crabs in bycatch samples taken on catcher-processors during the 1996-1999 Bristol Bay red king crab fisheries.

Year	Crab Sampled	Eyed Eggs		Uneyed Eggs		Barren, Mated		Barren, Non-mated	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1996	11	0	0.0	0	0.0	0	0.0	11	100.0
1997	70	46	65.7	13	18.6	0	0.0	11	15.7
1998	4,091	1,864	45.6	2,119	51.8	1	0.0	107	2.6
1999	36	0	0.0	31	86.1	1	2.8	4	11.1

Table 16. Results of legal tally samples taken on catcher-processors and floater-processors during the 1996-1999 Bristol Bay red king crab fisheries. Harvest figures include only those catches from catcher-processors and vessels that delivered to floater-processors.

Year	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested ^a	Estimated Number Illegal Crabs	Percent Harvest Sampled
		Number	Percent	Number	Percent					
1996	26,197	109	0.4	11	<0.1	8	0.5	257,717	1,259	10.2
1997	39,922	185	0.5	6	<0.1	5	0.5	1,603,768	7,874	2.5
1998	55,044	356	0.6	57	0.1	1	0.8	545,297	4,101	10.1
1999	39,965	304	0.8	0	0.0	3	0.8	288,341	2,215	13.9

^a ADF&G, Westward Region Staff 2000.

Table 17. Carapace size frequency distributions from biological measurements of retained hair crabs sampled during the 1996-1999 Bering Sea hair crab fisheries.

Length (mm)	1996		1997		1998		1999	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
61-65	0	0.0	0	0.0	0	0.0	0	0.0
66-70	0	0.0	0	0.0	5	0.2	0	0.0
71-75	17	0.3	9	0.2	7	0.3	1	0.1
76-80	185	3.3	87	2.0	65	2.4	14	1.4
81-85	570	10.2	303	7.1	195	7.1	64	6.4
86-90	1,132	20.2	672	15.8	340	12.4	122	12.3
91-95	1,629	29.1	1,065	25.0	532	19.4	225	22.7
96-100	1,412	25.2	1,217	28.6	723	26.4	343	34.6
101-105	567	10.1	698	16.4	619	22.6	178	17.9
106-110	85	1.5	190	4.5	222	8.1	44	4.4
Totals	5,597	99.8	4,241	99.5	2,708	98.7	991	99.9
	Mean Length =	92.9 mm	Mean Length =	95.0 mm	Mean Length =	96.3 mm	Mean Length =	96.0 mm

Table 18. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on 8 catcher-only vessels during the 1999 Bering Sea hair crab fishery. Standard errors of the CPUE estimates are included in parentheses. Data are from 2,232 sampled pot lifts.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
<u>hair crab</u>			
legal retained males	3,905	1.8 (0.03) ^b	158,000 ^c
legal not retained males	240	<0.1 ^d	9,400
sublegal males	329	<0.1 ^d	12,900
females	235	<0.1 ^d	9,250

^a Estimated CPUE multiplied by 92,333 total pot lifts (ADF&G, Westward Region staff 2000) during fishery.

^b Actual CPUE for retained legal crabs for the fishery as reported on confidential interviews forms was 1.5 for observed vessels; actual total fishery CPUE of retained legal crabs was 1.6 for all vessels (ADF&G, Westward Region staff 2000).

^c Actual catch of retained legal crabs for the fishery was 139,894 (ADF&G, Westward Region staff 2000).

^d CPUE computed as total pot sample catch divided by 2,232 pots sampled; standard errors of estimates were not computed.

Table 19. Total pot contents from 2,274 bycatch samples taken on 8 catcher-only vessels during the 1999 Bering Sea hair crab fishery.

Species		Total number observed
Hair crab	Legal Male	4,145
	Sublegal	329
	Female	235
Red king crab	Legal Male	76
	Sublegal	184
	Female	662
Blue king crab	Legal Male	46
	Sublegal	138
	Female	434
Tanner crab	Legal Male	11
	Sublegal	511
	Female	294
Snow crab	Legal Male	503
	Sublegal	25
	Female	4
Tanner crab, hybrid	Legal Male	12
	Sublegal	3
	Female	1
Starfish unidentified		8,873
Sculpin unidentified		221
Lyre crab		147
Pacific cod		134
Snail unidentified		89
Hermit crab unidentified		45
Sea urchin unidentified		23
Yellow Irish lord		10
Sea cucumber unidentified		8
Yellowfin sole		4
Decorator crab		3
Snailfish unidentified		3
Octopus		1

Table 20. Estimated CPUE of hair crabs by soak hours from 2,274 bycatch samples taken on eight catcher-only vessels during the 1999 Bering Sea hair crab fishery.

Soak Hours	Pots Sampled		Catch Per Sampled Pot				Total Crabs
	Number	Percent	Legal Retained	Legal Not Retained	Sublegal	Female	
1-12	33	1.5	1	<1	<1	<1	1
13-24	1012	44.5	2	<1	<1	<1	2
25-36	571	25.1	2	<1	<1	<1	2
37-48	194	8.5	2	<1	<1	<1	2
49-60	163	7.2	2	<1	<1	<1	2
61-72	57	2.5	1	<1	<1	<1	2
73-84	28	1.2	1	<1	<1	<1	1
85-96	124	5.5	2	<1	<1	<1	2
97-108	37	1.6	1	0	<1	<1	1
109-120	0	0.0	0	0	0	0	0
121-132	10	0.4	1	0	0	<1	2
133-144	5	0.2	0	0	0	0	0
145-156	0	0.0	0	0	0	0	0
157-168	0	0.0	0	0	0	0	0
169-180	0	0.0	0	0	0	0	0
181-192	6	0.3	2	0	0	0	2
193-204	15	0.7	1	0	0	0	1
205-216	13	0.6	1	0	0	<1	1
217-228	6	0.3	1	0	0	0	1
Mean Soak: 38 hours	Overall CPUE:		2	<1	<1	<1	2

Table 21. Estimated CPUE of hair crabs by depth from 2,274 bycatch samples taken on eight catcher-only vessels during the 1999 Bering Sea hair crab fishery.

Fathoms	Pots Sampled		Catch Per Sampled Pot				
	Number	Percent	Legal Retained	Legal Not Retained	Sublegal	Female	Total Crabs
11-20	1	<0.1	0	0	0	0	0
21-30	1,084	47.7	2	<1	<1	<1	2
31-40	1,116	49.1	2	<1	<1	<1	2
41-50	72	3.2	1	0	<1	<1	1
Mean Depth: 31 Fathoms	Overall CPUE:		2	<1	<1	<1	2

Table 22. Shell ages of male and female hair crabs in bycatch samples taken on catcher-only vessels during the 1994-1999 Bering Sea hair crab fisheries.

Year/ Sex	Sample Size	Shell Age Classes							
		Soft	%Total	New	%Total	Old	%Total	Very Old	%Total
1994									
Males	4,088	1	<0.1	3,437	84.1	595	14.6	55	1.3
Females	91	0	0.0	86	94.5	5	5.5	0	0.0
1995									
Males	13,663	2	<0.1	11,755	86.0	1,830	13.4	76	0.6
Females	708	0	0.0	644	91.0	62	8.8	2	0.3
1996									
Males	7,063	6	0.1	4,499	63.7	2,159	30.6	399	5.6
Females	573	11	1.9	516	90.1	41	7.2	5	0.9
1997									
Males	5,257	0	0.0	4,481	85.2	711	13.5	65	1.2
Females	193	0	0.0	178	92.2	14	7.3	1	0.5
1998									
Males	2,222	0	0.0	1,852	83.3	322	14.5	48	2.2
Females	428	0	0.0	401	93.7	24	5.6	3	0.7
1999									
Males	2,361	0	0	1,842	78.0	444	18.8	75	3.2
Females	120	0	0	116	96.7	3	2.5	1	0.8

Table 23. Reproductive condition of female hair crabs in bycatch samples taken on catcher-only vessels during the 1994-1999 Bering Sea hair crab fisheries.

Year	Crabs Sampled	Eyed Eggs		Uneyed Eggs		Barren, Mated		Barren, Non-mated	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1994	86	2	2.3	14	16.3	1	1.2	69	80.2
1995	692	94	13.6	18	2.6	148	21.4	432	62.4
1996	576	122	21.2	4	0.7	138	24.0	312	54.2
1997	195	7	3.6	2	1.0	70	35.9	116	59.5
1998	426	19	4.5	4	0.9	44	10.3	359	84.3
1999	122	20	16.4	1	0.8	7	5.7	94	77.0

Table 24. Results of legal tally samples taken on catcher-only vessels during the 1994 – 1999 Bering Sea hair crab fisheries.

Year	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested ^a	Estimated Number Illegal Crabs	Percent Harvest Sampled
		Number	Percent	Number	Percent					
1994	4,160	19	0.5	1	< 0.1	3	0.6	165,365	914	2.5
1995	45,527	161	0.4	25	< 0.1	60	0.5	1,433,478	7,746	3.2
1996	43,098	133	0.3	18	< 0.1	39	0.4	485,722	2,141	8.9
1997	27,133	39	0.1	16	< 0.1	36	0.3	420,121	1,409	6.5
1998	13,494	13	0.1	17	< 0.1	5	0.3	188,784	490	7.1
1999	13,257	20	0.2	8	0.1	5	0.2	139,894	348	9.5

^a ADF&G, Westward Region Staff 2000.

Table 25. Carapace size frequency distributions from biological measurements of retained golden king crabs sampled during the 1996 – 1999 Aleutain Islands golden king crab fisheries east of 174° W longitude.

Length (mm)	1996		1997		1998		1999	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
116-120	8	0.2	0	0.0	0	0.0	0	0.0
121-125	13	0.2	5	0.1	1	<0.1	0	0.0
126-130	34	0.6	36	0.5	15	0.2	17	0.3
131-135	332	6.0	510	6.7	423	5.2	381	6.1
136-140	915	16.6	1,460	19.2	1,502	18.5	1,401	22.6
141-145	1,191	21.6	1,797	23.7	1,846	22.8	1,537	24.8
146-150	1,058	19.2	1,446	19.1	1,596	19.7	1,148	18.5
151-155	740	13.4	990	13.0	1,094	13.5	720	11.6
156-160	511	9.3	648	8.5	713	8.8	454	7.3
161-165	318	5.8	363	4.8	434	5.4	280	4.5
166-170	195	3.5	203	2.7	270	3.3	158	2.6
171-175	115	2.1	83	1.1	147	1.8	71	1.1
176-180	60	1.1	45	0.6	48	0.6	33	0.5
181-185	11	0.2	5	0.1	20	0.3	7	0.1
186-190	3	0.1	1	<0.1	4	0.1	0	0.0
Totals	5,504	100.0	7,592	100.0	8,113	100.0	6,207	100.0
	Mean Length = 148.2 mm		Mean Length = 147.0 mm		Mean Length = 148.0 mm		Mean Length = 146.5 mm	

Table 26. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on one catcher-processor and 13 catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery (east of 174° W long.). Standard errors of the CPUE estimates are included in parentheses. Data are from 3,616 sampled pot lifts.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
<u>golden king crab</u>			
legal retained males	31,798	9.8 (0.30) ^b	820,000 ^c
legal not retained males	357	0.1 ^d	8,200
sublegal males	57,007	18.6 (0.7)	1,550,000
females	44,413	14.6 (0.8)	1,220,000

^a Estimated CPUE multiplied by 83,378 total pot lifts (ADF&G, Westward Region staff 2000) during fishery.

^b Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 9.1; actual total fishery CPUE of retained legal crabs was 8.9 for all vessels (ADF&G, Westward Region staff 2000).

^c Actual catch of retained legal crabs for the fishery was 740,011 (ADF&G, Westward Region staff 2000).

^d CPUE computed as total pot sample catch divided by 3,616 pots sampled; standard errors of estimates were not computed.

Table 27. Total pot contents from 3,616 bycatch samples taken on one catcher-processor and 13 catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery east of 174° W longitude.

Species		Total number observed
Golden king crab	Legal Male	32,155
	Sublegal	59,007
	Female	44,413
Scarlet king crab	Legal Male	76
	Sublegal	65
	Female	25
Grooved Tanner crab	Legal Male	5
	Sublegal	0
	Female	1
Tanner crab	Legal Male	0
	Sublegal	2
	Female	2
Hair crab	Legal Male	2
	Sublegal	0
	Female	0
Pacific halibut		506
Snail unidentified		289
Brittle star		279
Basket starfish unidentified		220
Pacific cod		150
Sea urchin unidentified		135
Greenland turbot		106
Sponge unidentified		100
Skate unidentified		61
Sculpin unidentified		56
Arrowtooth flounder		48
Starfish unidentified		47
Pribilof neptune (snail)		40
<i>Neptunea</i> sp.		37
Hairy triton		33
Lyre crab		25
Flatfish unidentified		11
Atka mackerel		8
Weathervane scallop		8
Rockfish unidentified		7
Sablefish		7
Octopus		5

-Continued-

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Species	Total number observed
Grenadiers; rattails	4
Shortspine thornyhead	3
Yellow Irish lord	2
Pacific ocean perch.	2
Rougheye rockfish	2
Sea anemone	1
Shrimp unidentified	1
Walleye pollock	1
Great sculpin	1

Table 28. Estimated CPUE of golden king crabs by soak hours from 3,616 bycatch samples taken on one catcher-processor and 13 catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery east of 174° W longitude.

Soak Hours	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
1-24	23	0.6	3	10	2	16
25-48	479	13.2	5	15	10	30
49-72	764	21.1	8	17	15	40
73-96	983	27.2	8	15	11	34
97-120	494	13.7	10	16	10	37
121-144	191	5.3	12	24	16	51
145-168	162	4.5	12	19	13	44
169-192	167	4.6	13	19	15	47
193-216	156	4.3	13	13	18	44
217-240	100	2.8	11	18	12	42
241-264	44	1.2	15	14	14	44
265-288	23	0.6	11	4	7	22
289-312	12	0.3	17	10	2	29
313-336	7	0.2	4	2	5	11
337-360	0	0.0	0	0	0	0
361-384	4	0.1	12	44	22	78
385-408	1	0.0	6	1	4	11
409-432	0	0.0	0	0	0	0
433-456	0	0.0	0	0	0	0
457-480	3	0.1	4	0	0	4
481-504	3	0.1	3	2	2	6
Mean Soak: 103 hours	Overall CPUE:		9	16	12	38

Table 29. Estimated CPUE of golden king crabs by depth from 3,616 bycatch samples taken on one catcher-processor and 13 catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery east of 174° W longitude.

Fathoms	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
1-25	2	0.1	7	15	40	61
51-75	5	0.1	18	11	0	29
76-100	447	12.4	6	13	3	22
101-125	628	17.4	9	13	6	28
126-150	611	16.9	8	9	6	23
151-175	546	15.1	9	10	9	28
176-200	356	9.9	10	16	13	40
201-225	290	8.0	10	22	23	55
226-250	290	8.0	10	27	22	60
251-275	198	5.5	12	24	25	61
276-300	143	4.0	10	33	28	71
301-325	57	1.6	9	38	35	82
326-350	21	0.6	9	43	50	102
351-375	14	0.4	8	57	51	116
376-400	4	0.1	4	10	8	22
401-425	1	<0.1	1	0	0	1
426-451	1	<0.1	0	0	0	0
Mean Depth: 168 Fathoms	Overall CPUE:		9	16	12	38

Table 30. Shell ages of male and female golden king crabs in bycatch samples taken on catcher-processors and catcher-only vessels during the 1996-1999 Aleutian Islands golden king crab fisheries east of 174° W longitude.

Year/ Sex	Sample Size	Shell Age Classes							
		Soft	%Total	New	%Total	Old	%Total	Very Old	%Total
1996									
Males	93,386	24	<0.1	91,629	98.1	1,623	1.7	110	0.1
Females	59,259	25	<0.1	58,148	98.1	1,068	1.8	18	<0.1
1997									
Males	83,708	62	0.1	80,430	96.1	3,127	3.7	89	0.1
Females	54,375	55	0.1	52,453	96.5	1,865	3.4	2	<0.1
1998									
Males	91,162	2	<0.1	88,189	96.7	2,163	2.4	210	0.2
Females	44,410	2	<0.1	43,748	98.5	426	1.0	4	<0.1
1999									
Males	79,067	1	<0.1	76,133	96.3	1,935	2.4	201	0.3
Females	36,678	1	<0.1	36,086	98.4	325	0.9	15	<0.1

Table 31. Reproductive condition of female golden king crabs in bycatch samples taken on catcher-processors and catcher-only vessels during the 1996-1999 Aleutian Islands golden king crab fisheries east of 174° W longitude.

Year	Crabs Sampled	Eyed Eggs		Uneyed Eggs		Barren, Mated		Barren, Non-mated	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1996	59,210	12,328	20.8	13,339	22.5	10,997	18.6	22,546	38.1
1997	54,383	13,692	25.2	10,514	19.3	11,996	22.1	18,181	33.4
1998	44,352	8,021	18.1	9,333	21.0	10,601	23.9	16,397	37.0
1999	36,659	8,111	22.1	7,714	21.0	8,453	23.1	12,381	33.8

Table 32. Results of legal tally samples taken on catcher-processors and catcher-only vessels during the 1996/1997 – 1998/1999 Aleutian Islands golden king crab fisheries for the entire registration area.

Year	Sample Size	Male		Female		Other Crabs	Total Percent Illegal	Number Crabs Harvested ^a	Estimated Number Illegal Crabs	Percent Harvest Sampled
		Number	Percent	Number	Percent					
1996/1997	178,326	1,098	0.6	79	<0.1	0	0.7	1,343,950	8,870	13.3
1997/1998	182,134	973	0.5	93	<0.1	0	0.6	1,350,159	2,092	13.5
1998/1999	141,459	706	0.5	42	<0.1	0	0.5	1,149,542	6,078	12.3

^a ADF&G, Westward Region Staff 2000.

Table 33. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on one catcher-processor and 14 catcher-only vessels during the 1999 Aleutian Islands golden king crab fishery (east of 174° W long.). Standard errors of the CPUE estimates are included in parentheses. Data are from 3,851 sampled pot lifts.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
<u>golden king crab</u>			
legal retained males	34,650	9.2 (0.15) ^b	730,000 ^c
legal not retained males	472	0.1 ^d	9,800
sublegal males	44,057	12.7 (0.3)	1,000,000
females	36,689	11.2 (0.4)	890,000

^a Estimated CPUE multiplied by 79,129 total pot lifts (ADF&G, Westward Region staff 2000) during fishery.

^b Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 8.8; actual total fishery CPUE of retained legal crabs was 9.0 for all vessels (ADF&G, Westward Region staff 2000).

^c Actual catch of retained legal crabs for the fishery was 709,332 (ADF&G, Westward Region staff 2000).

^d CPUE computed as total pot sample catch divided by 3,851 pots sampled; standard errors of estimates were not computed.

Table 34. Total pot contents from 3,851 bycatch samples taken on one catcher-processor and 14 catcher-only vessels during the 1999 Aleutian Islands golden king crab fishery east of 174° W longitude.

Species		Total number observed
Golden king crab	Legal Male	35,122
	Sublegal	44,057
	Female	36,692
Scarlet king crab	Legal Male	59
	Sublegal	5
	Female	22
Grooved Tanner crab	Legal Male	1
	Sublegal	4
	Female	1
Tanner crab	Legal Male	0
	Sublegal	1
	Female	5
Hair crab	Legal Male	0
	Sublegal	0
	Female	1
Red king crab	Legal Male	0
	Sublegal	0
	Female	1
Tanner/snow crab hybrid	Legal Male	0
	Sublegal	0
	Female	1
<i>Paralomis</i> sp.		1
Pacific halibut		630
Starfish unidentified		333
Sponge unidentified		268
Brittle star		205
Pacific cod		153
Basket starfish unidentified		98
Snail unidentified		80
Arrowtooth flounder		73
Sea urchin unidentified		58
Rockfish unidentified		52
Greenland turbot		41
Skate unidentified		39
Sculpin unidentified		23
Lyre crab		23
Hairy triton		17
Sablefish		15

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Species	Total number observed
Bigmouth sculpin	6
Sea anemone	6
Flatfish unidentified	5
Yellow Irish lord	5
Rougheye rockfish	3
Walleye pollock	3
Great sculpin	3
Octopus	2
Pacific ocean perch.	2
Pribilof neptune (snail)	2
Grenadiers; rattails	1
Shortspine thornyhead	1
Rock sole	1
Scaled crab	1
Scallop unidentified	1
Shrimp unidentified	1
Dusky rockfish	1
Prowfish	1

Table 35. Estimated CPUE of golden king crabs by soak hours from 3,851 bycatch samples taken on one catcher-processor and 14 catcher-only vessels during the 1999 Aleutian Islands golden king crab fishery east of 174° W longitude.

Soak Hours	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
1-24	6	0.2	2	1	1	4
25-48	268	7.0	4	8	10	22
49-72	997	25.9	7	11	11	28
73-96	1161	30.2	8	11	9	28
97-120	435	11.3	11	14	9	34
121-144	272	7.1	11	12	11	35
145-168	313	8.1	11	12	8	31
169-192	163	4.2	14	10	7	30
193-216	115	3.0	20	19	14	53
217-240	75	2.0	15	13	8	36
241-264	20	0.5	24	28	15	66
265-288	15	0.4	13	8	9	31
289-312	0	0.0	0	0	0	0
313-336	2	0.1	3	3	10	16
337-360	1	<0.1	29	6	7	42
361-384	0	0.0	0	0	0	0
385-408	0	0.0	0	0	0	0
409-432	0	0.0	0	0	0	0
433-456	0	0.0	0	0	0	0
457-480	1	<0.1	3	12	12	27
553-576	1	<0.1	19	3	63	85
Mean Soak: 101 hours	Overall CPUE:		9	11	10	30

Table 36. Estimated CPUE of golden king crabs by depth from 3,851 bycatch samples taken on one catcher-processor and 14 catcher-only vessels during the 1999 Aleutian Islands golden king crab fishery east of 174° W longitude.

Fathoms	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
26-50	1	0.0	0	2	12	14
51-75	9	0.2	4	5	2	11
76-100	216	5.6	16	20	7	43
101-125	742	19.3	9	10	5	24
126-150	814	21.2	7	7	6	20
151-175	640	16.6	8	8	7	23
176-200	420	10.9	9	11	11	31
201-225	327	8.5	9	12	13	34
226-250	226	5.9	9	16	18	43
251-275	192	5.0	10	17	16	42
276-300	142	3.7	11	21	17	50
301-325	75	1.9	12	31	30	72
326-350	31	0.8	6	31	37	74
351-375	8	0.2	14	60	59	132
376-400	3	0.1	4	21	19	44
401-425	0	0.0	0	0	0	0
426-450	0	0.0	0	0	0	0
451-475	1	<0.1	1	11	3	15
Mean Depth: 170 Fathoms	Overall CPUE:		9	11	10	30

Table 37. Carapace size frequency distributions from biological measurements of retained golden king crabs sampled during the 1996/1997 – 1998/1999 Aleutain Islands golden king crab fisheries west of 174° W longitude.

Length (mm)	1996/1997		1997/1998		1998/1999	
	Number	Percent	Number	Percent	Number	Percent
116-120	0	0.0	0	0.0	1	<0.1
121-125	0	0.0	3	<0.1	0	0.0
126-130	90	0.3	89	0.3	43	0.2
131-135	1,824	6.6	1,651	5.6	1,128	5.6
136-140	5,921	21.4	5,741	19.5	4,410	21.8
141-145	6,555	23.7	7,096	24.1	5,403	26.7
146-150	5,231	18.9	5,563	18.9	4,179	20.7
151-155	3,442	12.5	3,785	12.9	2,502	12.4
156-160	2,023	7.3	2,353	8.0	1,349	6.7
161-165	1,267	4.6	1,442	4.9	660	3.3
166-170	750	2.7	859	2.9	324	1.6
171-175	335	1.2	446	1.5	144	0.7
176-180	157	0.6	230	0.8	45	0.2
181-185	36	0.1	99	0.3	18	0.1
186-190	9	<0.1	21	0.1	10	0.1
Totals	27,640	100.0	29,378	100.0	20,216	100.0
	Mean Length =	146.8 mm	Mean Length =	147.5 mm	Mean Length =	146.0 mm

Table 38. Estimated catch per pot (CPUE) of selected crab species from pot lifts sampled by observers deployed on one catcher-processor and two catcher-only vessels during the 1998/1999 Aleutian Islands golden king crab fishery (west of 174° W long.). Standard errors of the CPUE estimates are included in parentheses. Data are from 1,351 sampled pot lifts.

Species / Sex Class	Total Pot Sample Catch	Estimated CPUE For Sampled Fleet	Estimated Total Fishery Catch ^a
<u>golden king crab</u>			
legal retained males	14,830	11.1 (0.30) ^b	400,000 ^c
legal not retained males	64	<0.1 ^d	1,700
sublegal males	21,597	15.3 (0.7)	550,000
females	22,252	15.2 (0.8)	545,000

^a Estimated CPUE multiplied by 35,920 total pot lifts (ADF&G, Westward Region staff 200) during fishery.

^b Actual CPUE for retained legal crabs for the fishery as reported on confidential interview forms was 11.7; actual total fishery CPUE of retained legal crabs was 11.4 for all vessels (ADF&G, Westward Region staff 1999).

^c Actual catch of retained legal crabs for the fishery was 409,531 (ADF&G, Westward Region staff 1999).

^d CPUE computed as total pot sample catch divided by 1,350 pots sampled; standard errors of estimates were not computed.

Table 39. Total pot contents from 1,351 bycatch samples taken on one catcher-processor and two catcher-only vessels during the 1998/1999 Aleutian Islands golden king crab fishery west of 174° W longitude.

Species		Total number observed
Golden king crab	Legal Male	14,894
	Sublegal	21,597
	Female	22,252
Scarlet king crab	Legal Male	75
	Sublegal	3
	Female	17
Grooved Tanner crab	Legal Male	2
	Sublegal	0
	Female	0
Hair crab	Legal Male	1
	Sublegal	1
	Female	0
Red king crab	Legal Male	5
	Sublegal	2
	Female	3
Triangle Tanner crab	Legal Male	1
	Sublegal	0
	Female	0
<i>Paralomis multispina</i>	Legal Male	0
	Sublegal	0
	Female	1
Pacific halibut		42
Starfish unidentified		41
Snail unidentified		36
Pacific cod		24
Pacific ocean perch		21
Sea urchin unidentified		10
Sculpin unidentified		10
Rougheye rockfish		6
Scaled crab		6
Octopus		5
Arrowtooth flounder		5
Skate unidentified		4
Greenland turbot		3
Shortspine thornyhead		2
Sea cucumber unidentified		1
Grenadiers; rattails		1
Sablefish		1
Brittle star		1

Table 40. Estimated CPUE of golden king crabs by soak hours from 1,351 bycatch samples taken on one catcher-processor and two catcher-only vessels during the 1998/1999 Aleutian Islands golden king crab fishery west of 174° W longitude.

Soak Hours	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
1-48	59	4.4	2	3	2	8
49-96	20	1.5	2	6	3	11
97-144	232	17.2	9	14	15	38
145-192	505	37.4	10	19	20	49
193-240	130	9.6	14	20	18	52
241-288	117	8.7	12	14	19	45
289-336	127	9.4	13	17	19	49
337-384	57	4.2	16	15	13	44
385-432	15	1.1	19	21	12	52
433-480	24	1.8	13	9	9	31
481-528	7	0.5	6	2	2	11
529-576	6	0.4	7	3	1	11
577-624	11	0.8	18	7	3	28
625-672	10	0.7	9	17	2	29
673-720	3	0.2	11	4	4	19
721-768	2	0.1	7	1	3	11
769-816	14	1.0	23	19	9	51
817-864	7	0.5	31	10	11	53
865-912	0	0.0	0	0	0	0
913-960	3	0.2	8	29	13	50
Mean Soak: 225 hours	Overall CPUE:		11	16	16	43

Table 41. Estimated CPUE of golden king crabs by depth from 1,351 bycatch samples taken on one catcher-processor and two catcher-only vessels during the 1998/1999 Aleutian Islands golden king crab fishery west of 174° W longitude.

Fathoms	Pots Sampled		Catch Per Sampled Pot			
	Number	Percent	Legal	Sublegal	Female	Total Crabs
51-75	3	0.2	5	1	3	9
76-100	44	3.3	8	13	17	38
101-125	118	8.8	7	10	8	24
126-150	171	12.7	12	16	10	38
151-175	247	18.4	10	15	9	35
176-200	298	22.1	11	15	14	40
201-225	180	13.4	11	17	27	55
226-250	177	13.2	13	16	27	56
251-275	55	4.1	14	17	25	56
276-300	30	2.2	15	33	32	80
301-325	20	1.5	13	34	23	69
326-350	3	0.2	18	39	6	63
Mean Depth: 185 Fathoms	Overall CPUE:		11	16	16	43

Table 42. Shell ages of male and female golden king crabs in bycatch samples taken on catcher-processors and catcher-only vessels during the 1996/1997-1998/1999 Aleutian Islands golden king crab fisheries west of 174° W longitude.

Year/ Sex	Sample Size	Shell Age Classes							
		Soft	%Total	New	%Total	Old	%Total	Very Old	%Total
1996/1997									
Males	82,600	90	0.1	80,632	97.6	1,762	2.1	116	0.1
Females	67,459	87	0.1	64,489	95.6	2,869	4.3	14	<0.1
1997/1998									
Males	55,643	46	0.1	53,455	96.1	1,862	3.3	280	0.5
Females	39,322	50	0.1	38,818	98.7	443	1.1	11	<0.1
1998/1999									
Males	36,047	4	<0.1	35,464	97.2	526	1.4	53	0.1
Females	22,086	3	<0.1	21,906	98.5	172	0.8	5	<0.1

Table 43. Reproductive condition of female golden king crabs in bycatch samples taken on catcher-processors and catcher-only vessels during the 1996/1997-1998/1999 Aleutian Islands golden king crab fisheries west of 174° W longitude.

Year	Crabs Sampled	Eyed Eggs		Uneyed Eggs		Barren, Mated		Barren, Non-mated	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1996/1997	67,314	15,907	23.6	17,187	25.5	14,303	21.2	19,917	29.6
1997/1998	39,343	9,459	24.0	10,538	26.8	7,779	19.8	11,567	29.4
1998/1999	22,208	5,202	23.4	5,755	25.9	3,613	16.3	7,638	34.4

Table 44. Observer coverage, pot sampling effort by observers, and relative difference of observer-based CPUE estimates for retained legal crabs from the Actual Observed Fleet CPUE and from the Actual Total Fishery CPUE. Data is from crab fisheries with mandatory observers.

Fishery (Table in report referenced)	Vessels		Pot lifts		Percent difference of observer-based CPUE estimate from:	
	Observed	Total Fishery	Observer Sampled	Total Fishery	Confidential Interview CPUE ^a	Actual Total Fishery CPUE ^b
Bering Sea snow crab (Table 2)	10	242	1,507	899,043	-20.8% (159.1)	-21.0% (159.4)
Bering Sea snow crab, including legal hybrids	10	242	1,507	899,043	-7.7% (159.1)	-7.8% (159.4)
Bristol Bay red king crab (Table 10)	9	258	178	146,997	10.7% (12.1)	10.7% (12.1)
Bering Sea hair crab (Table 18)	8	8	2,232	92,333	-12.5% (1.6)	--
1998 Aleutian Islands golden king crab east of 174° W long. (Table 26)	14	14	3,616	83,378	7.6% (9.1)	--
1999 Dutch Harbor golden king crab east of 174° W long. (Table 33)	15	15	3,851	79,129	-4.5% (8.8)	--
1998-99 Aleutian Islands golden king crab west of 174° W long. (Table 38)	3	3	1,351	35,920	-4.7% (11.2)	--

^a confidential Interview (CI) CPUE is based on confidential interviews with vessel operators. Percent difference is computed as: $\{[(\text{Observer-based CPUE}) - (\text{CI CPUE})]/(\text{CI CPUE})\} \times 100\%$. CPUE from confidential interviews in parentheses.

^b Actual Total Fishery (ATF) CPUE is based on fish ticket data on all landings in the fishery. Percent difference is computed as: $\{[(\text{Observer-based CPUE}) - (\text{ATF CPUE})]/(\text{ATF CPUE})\} \times 100\%$. Computed only for fisheries with partial observer coverage; CPUE from fish tickets in parentheses.

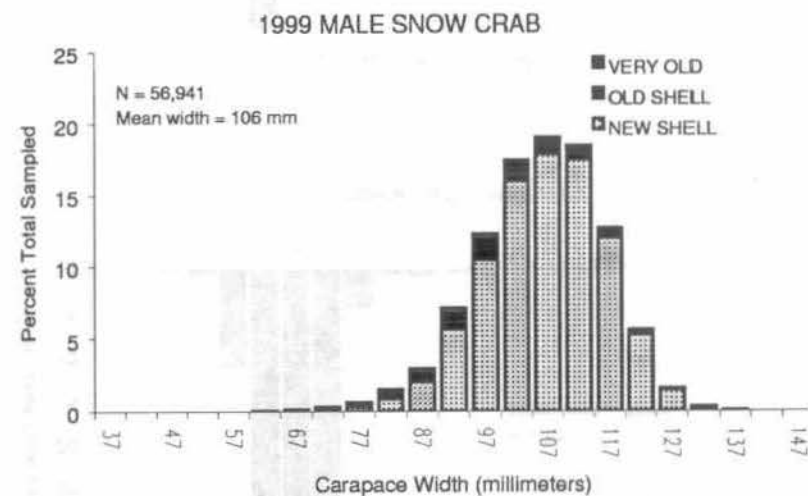
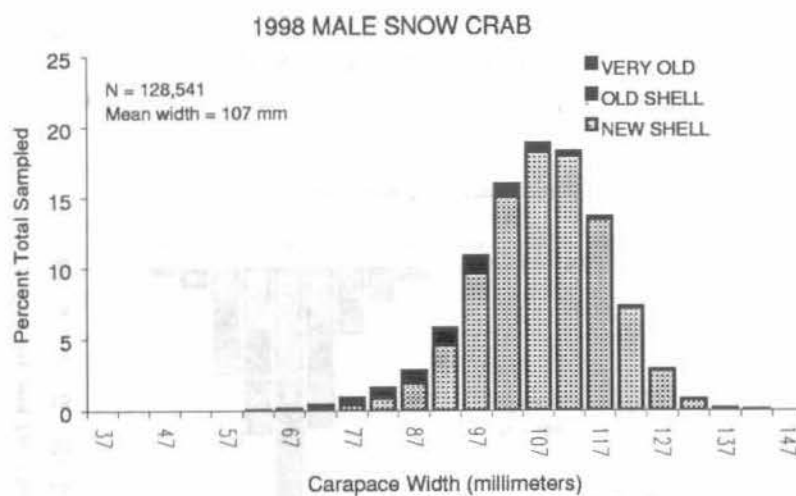
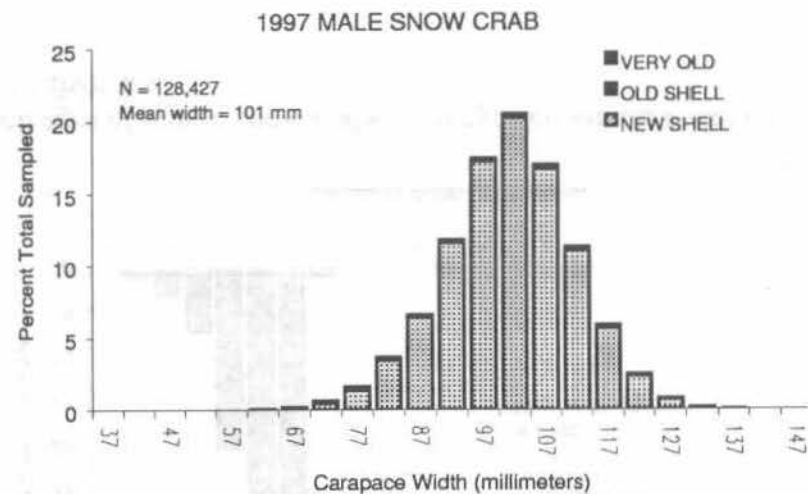
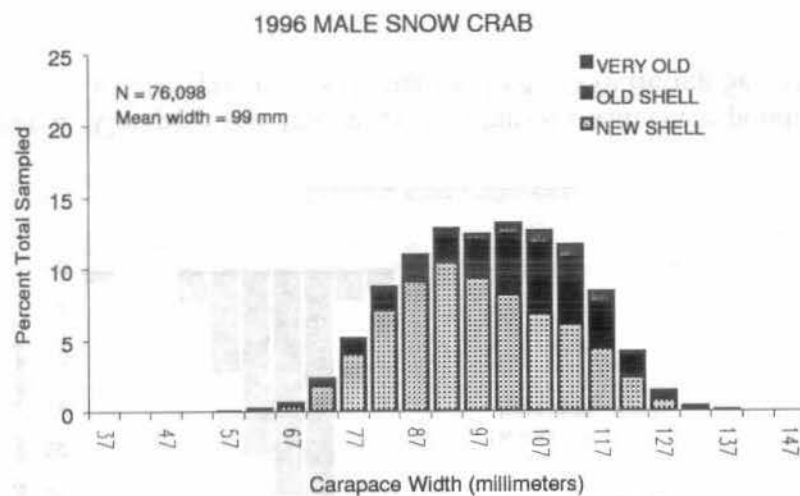


Figure 1. Carapace size frequency distributions with corresponding shell ages of male snow crabs from bycatch samples taken on catcher-processors during the 1996-1999 Bering Sea snow crab fisheries.

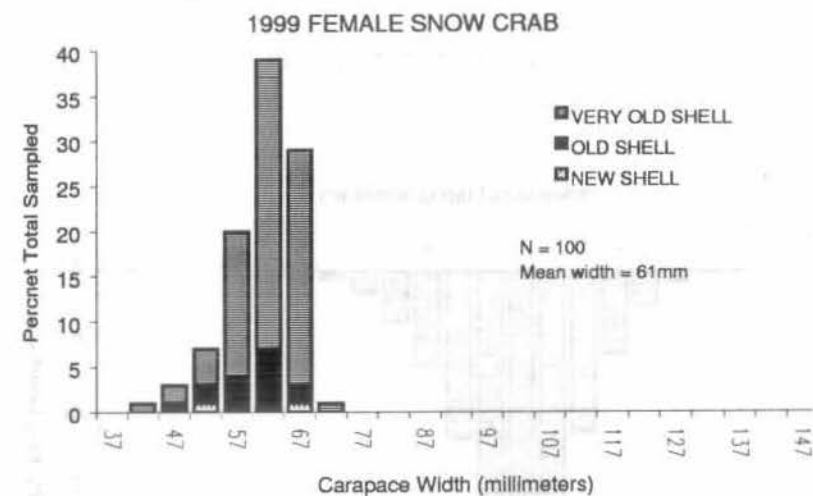
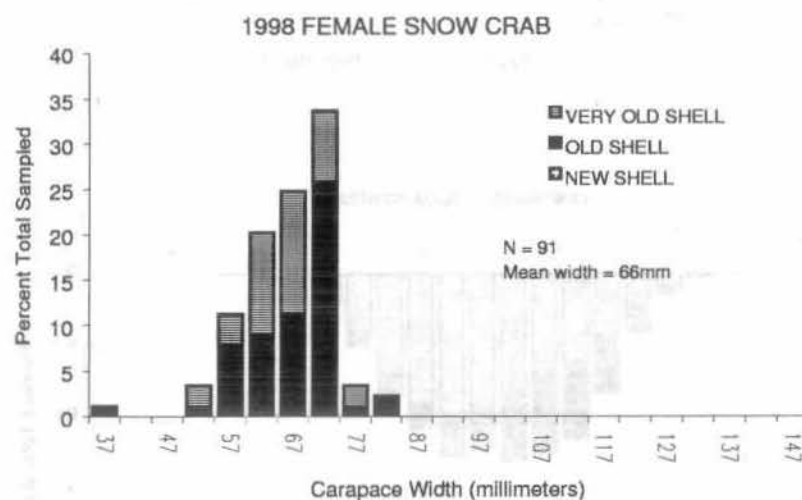
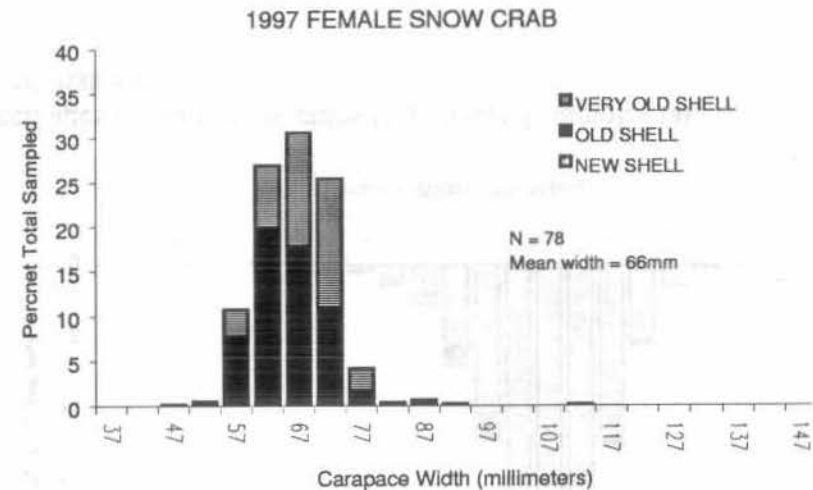
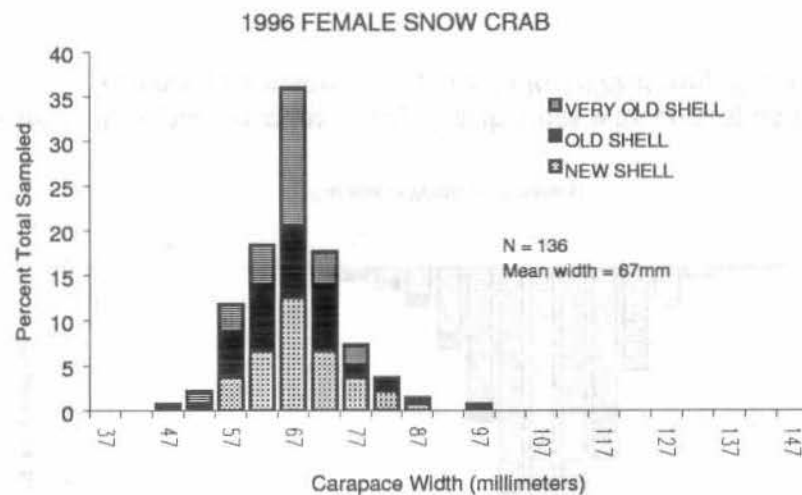


Figure 2. Carapace size frequency distributions with corresponding shell ages of female snow crabs from bycatch samples taken on catcher-processors during the 1996-1999 Bering Sea snow crab fisheries.

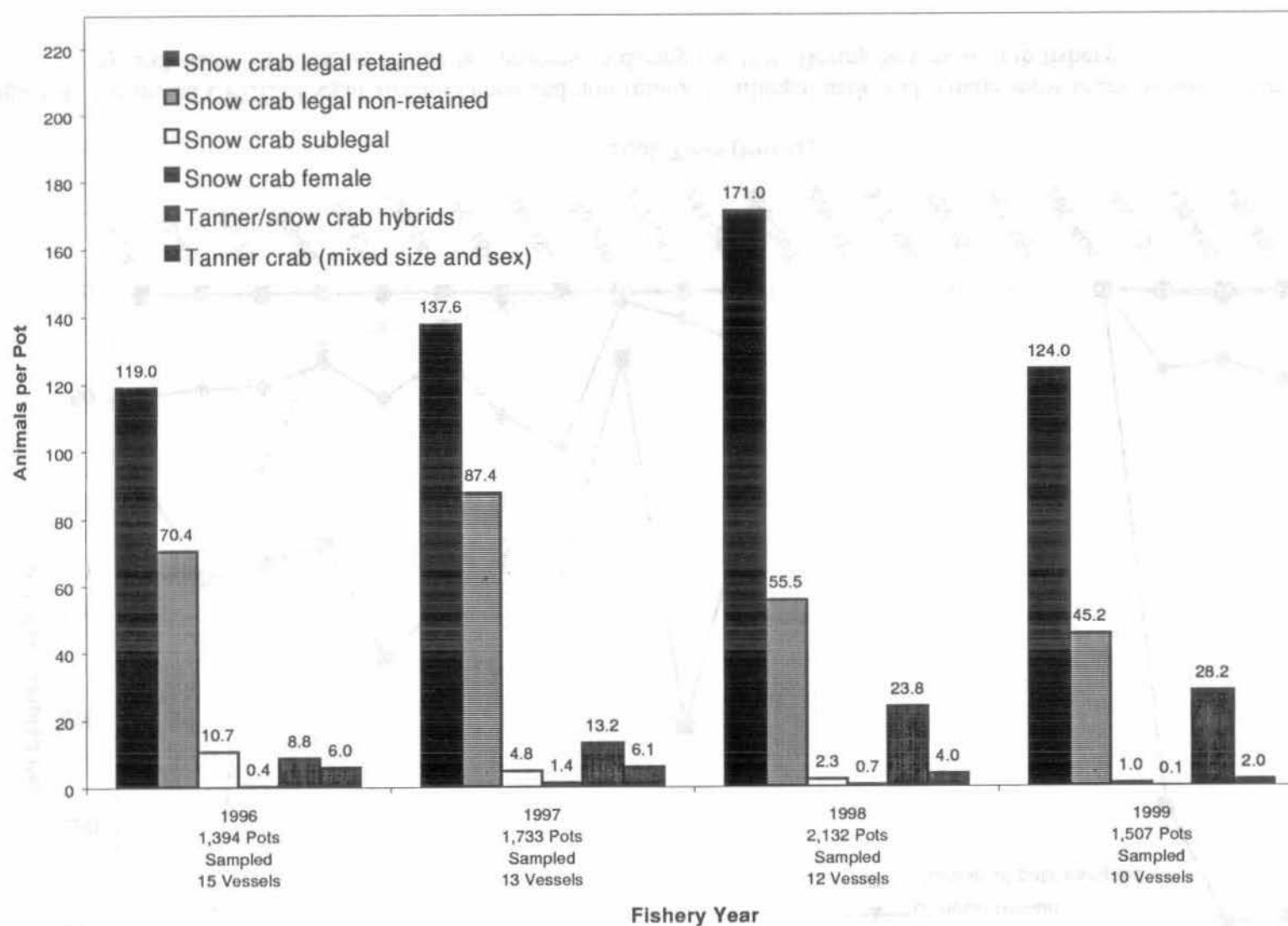


Figure 3. Estimated CPUE of selected species from bycatch samples taken on catcher-processors during the 1996-1999 Bering Sea snow crab fisheries.

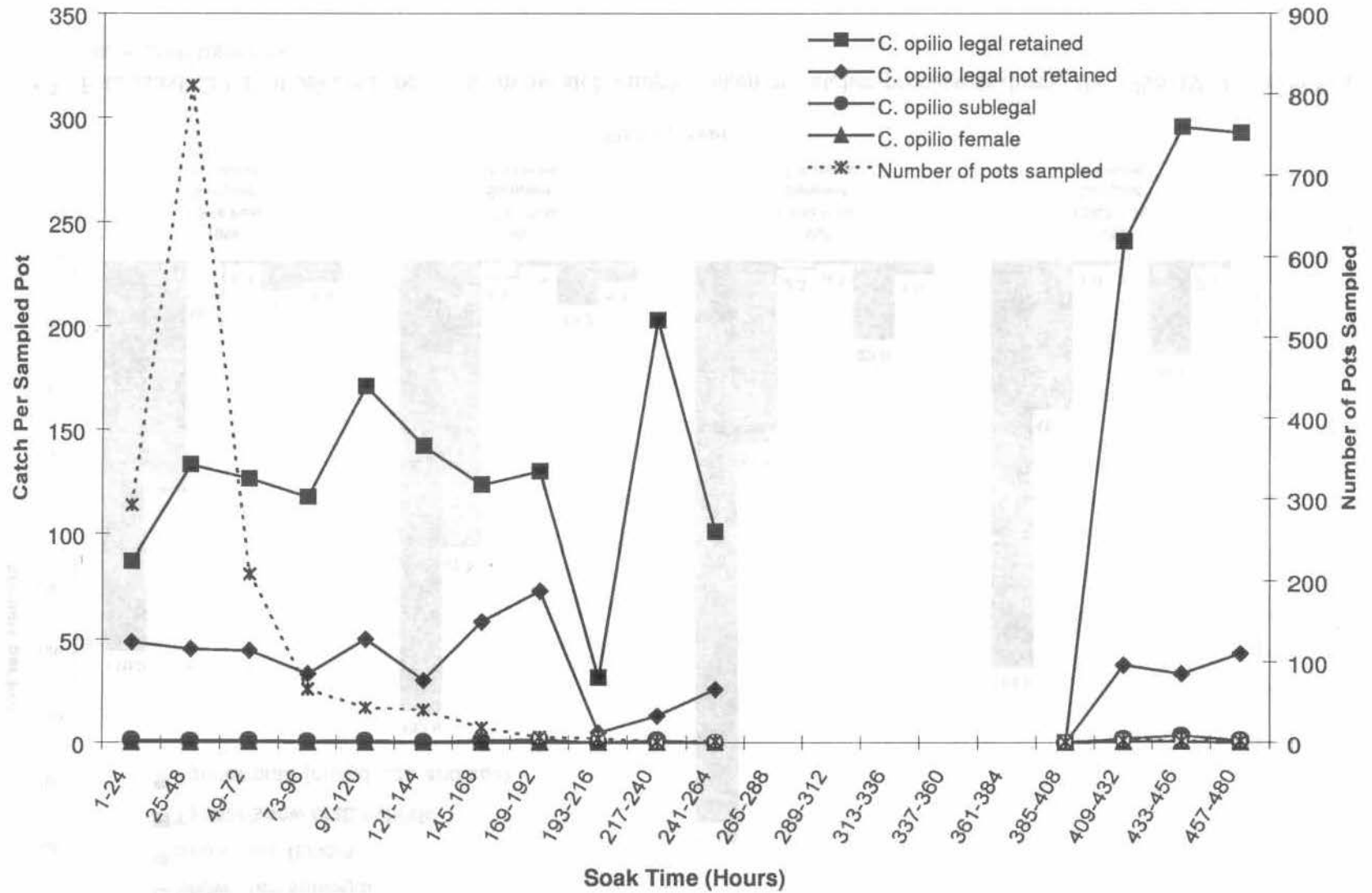


Figure 4. Estimated CPUE of legal-sized retained and non-retained, sublegal male and female snow crabs by soak hours from 1,507 bycatch samples taken on 10 catcher-processors during the 1999 Bering Sea snow crab fishery.

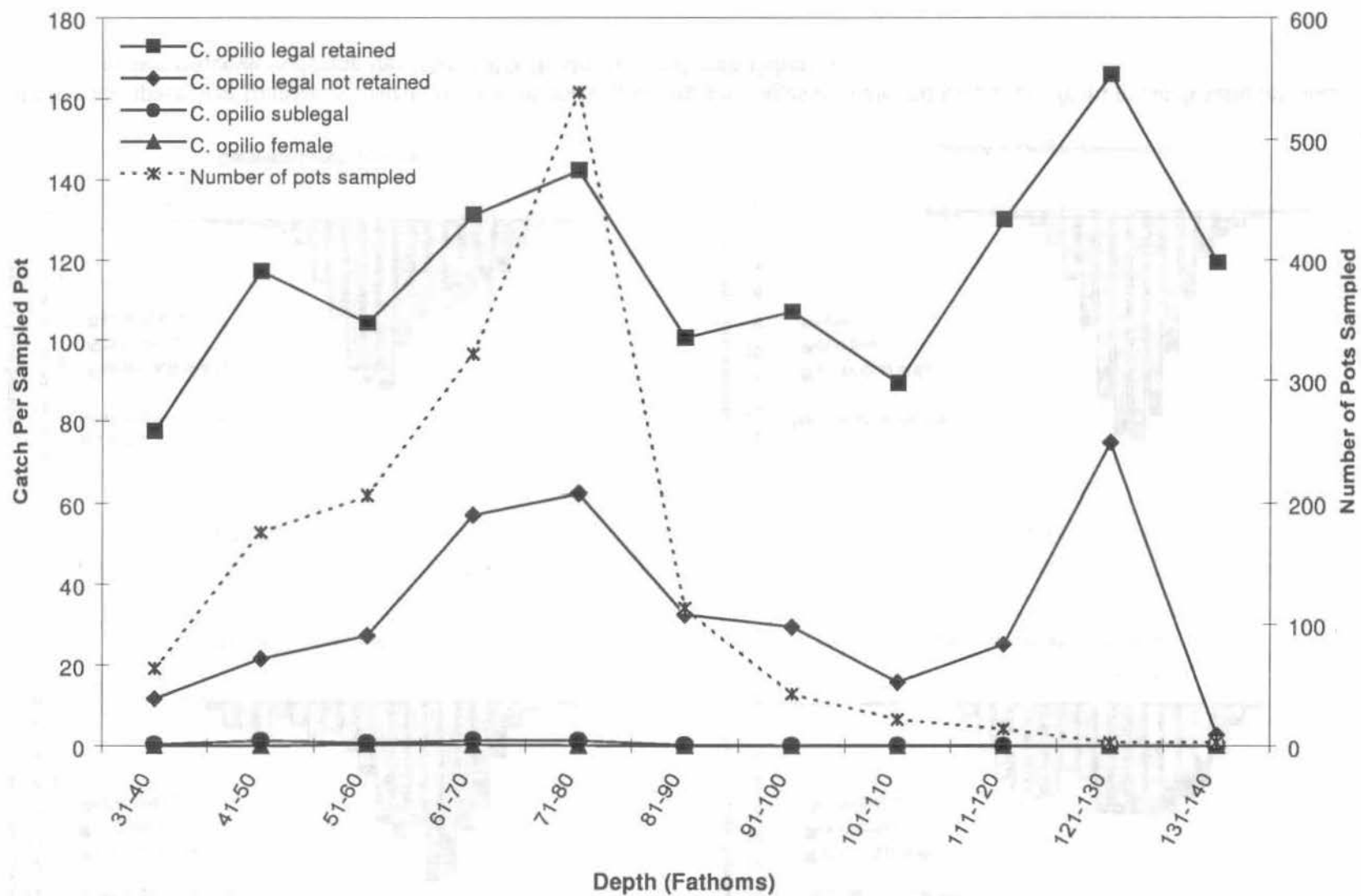
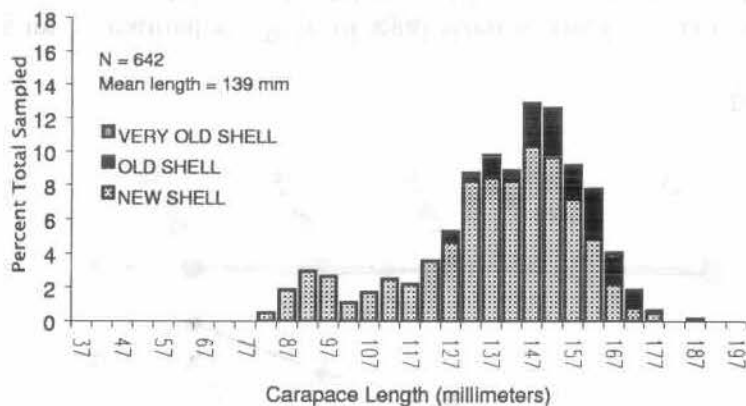
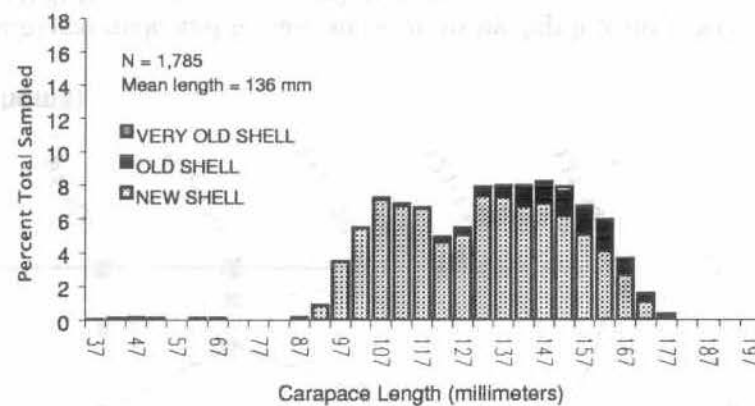


Figure 5. Estimated CPUE of legal-sized retained and non-retained, sublegal male and female snow crabs by depth from 1,507 bycatch samples taken on 10 catcher-processors during the 1999 Bering Sea snow crab fishery.

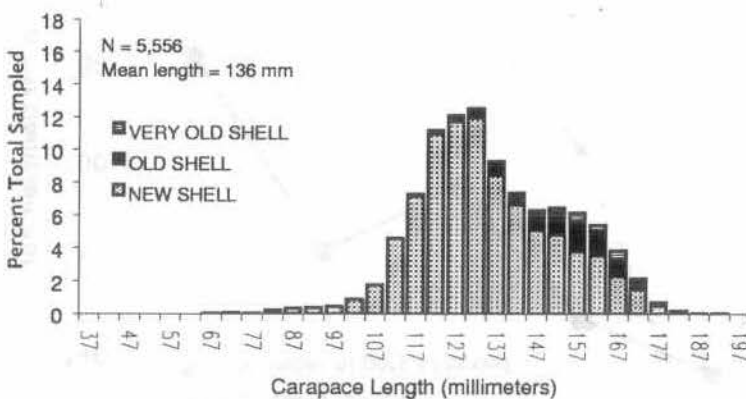
1996 MALE RED KING CRAB



1997 MALE RED KING CRAB



1998 MALE RED KING CRAB



1999 MALE RED KING CRAB

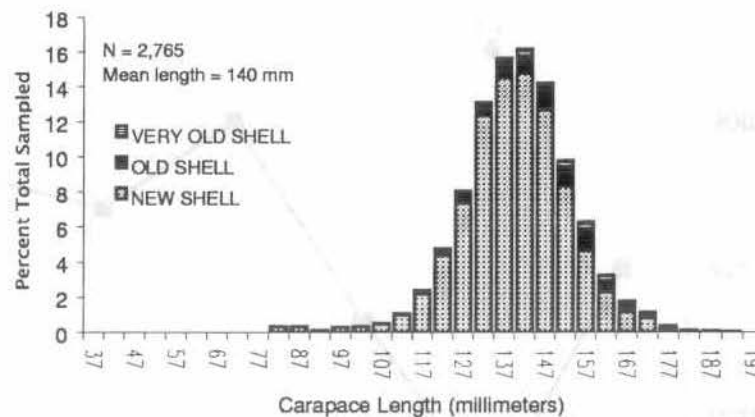
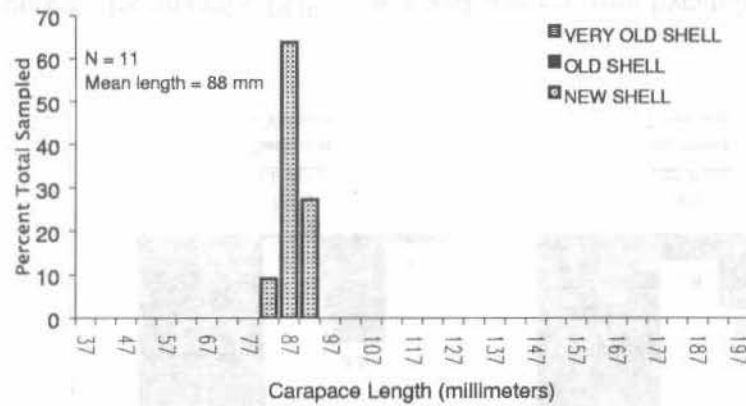
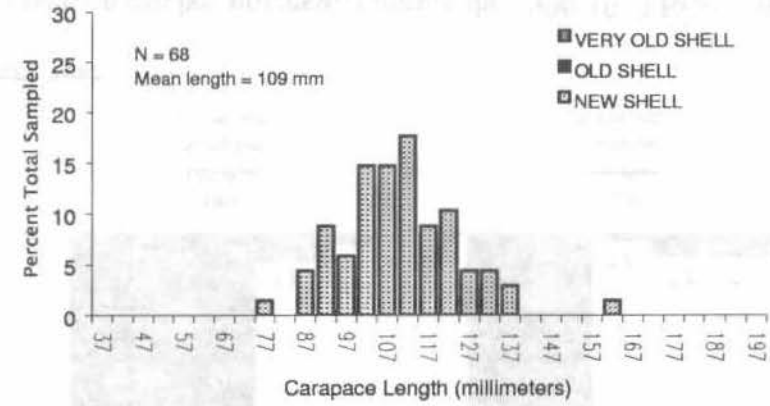


Figure 6. Carapace size frequency distributions with corresponding shell ages of male red king crabs from bycatch samples taken on catcher-processors during the 1996-1999 Bristol Bay red crab fisheries.

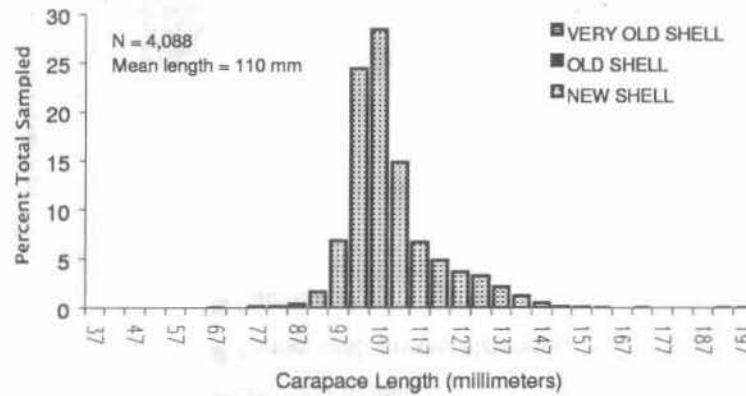
1996 FEMALE RED KING CRAB



1997 FEMALE RED KING CRAB



1998 FEMALE RED KING CRAB



1999 FEMALE RED KING CRAB

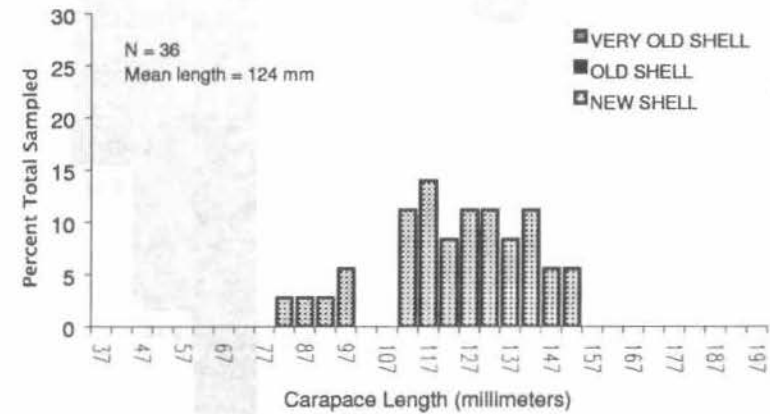


Figure 7. Carapace size frequency distributions with corresponding shell ages of female red king crabs from bycatch samples taken on catcher-processors during the 1996-1999 Bristol Bay red crab fisheries.

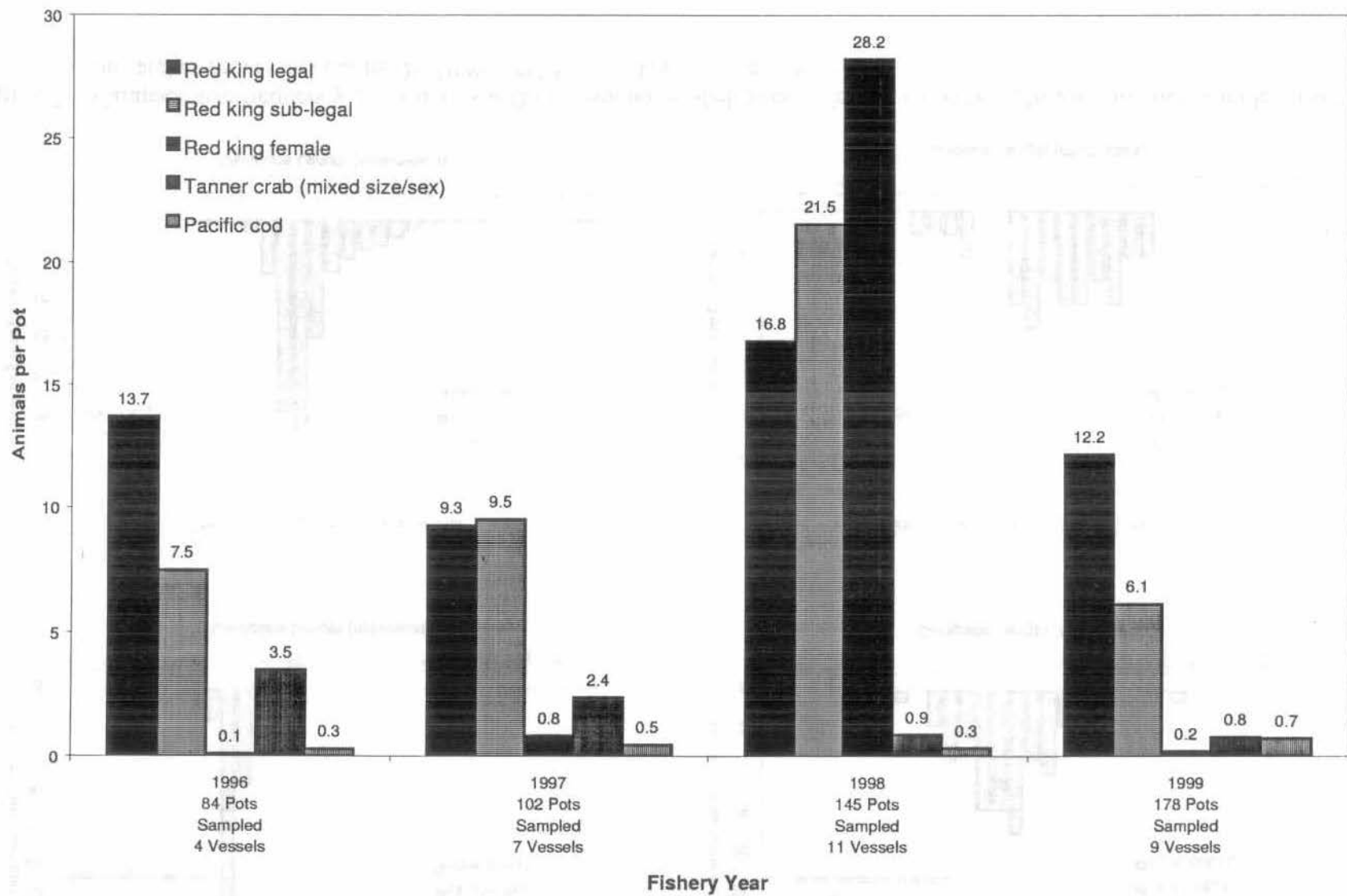


Figure 8. Estimated CPUE of selected species from bycatch samples taken on catcher-processors during the 1996-1999 Bristol Bay red king crab fisheries.

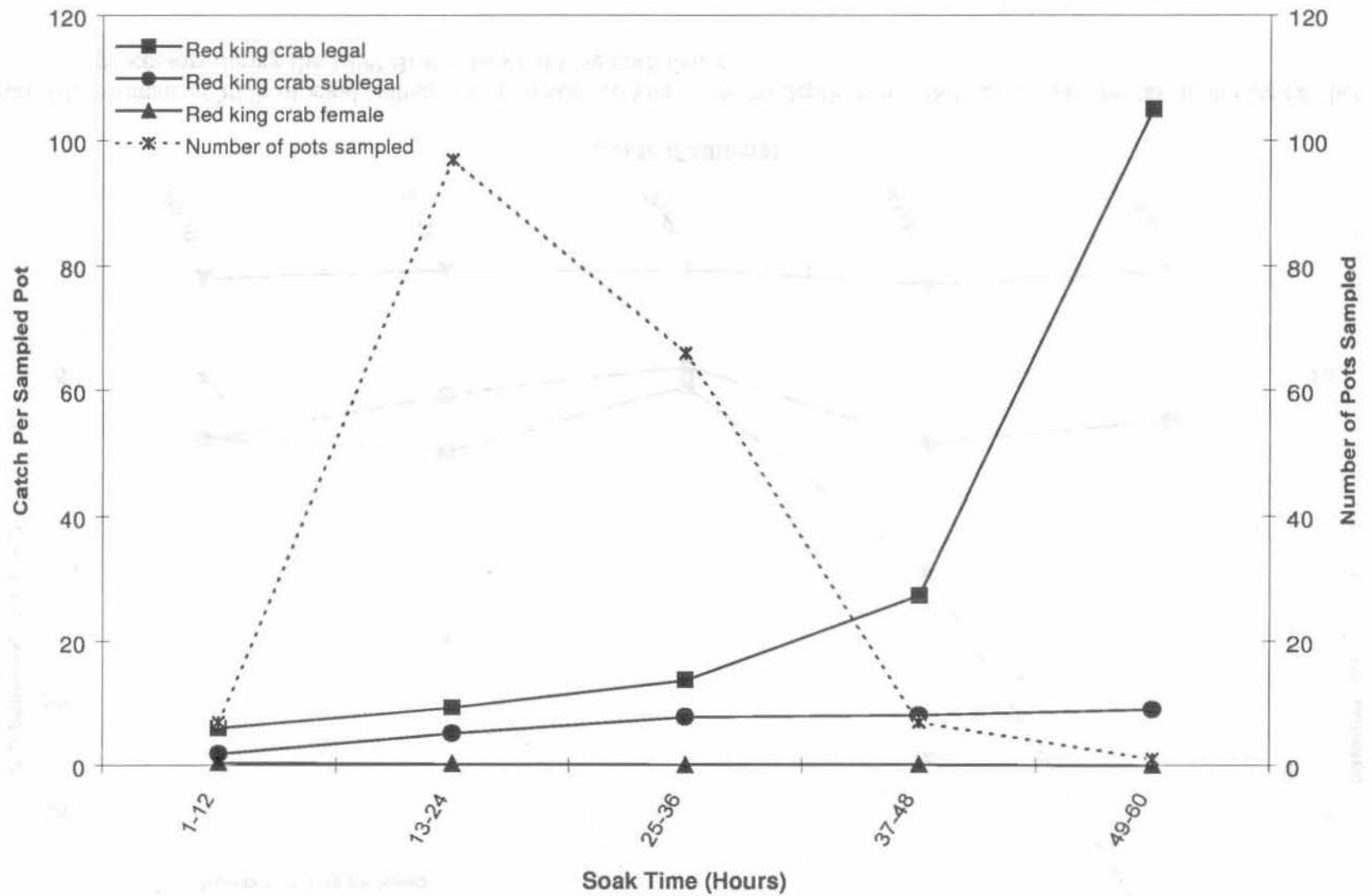


Figure 9. Estimated CPUE of legal, sublegal and female red king crabs by soak hours from 178 bycatch samples taken on nine catcher-processors during the 1999 Bristol Bay red king crab fishery.

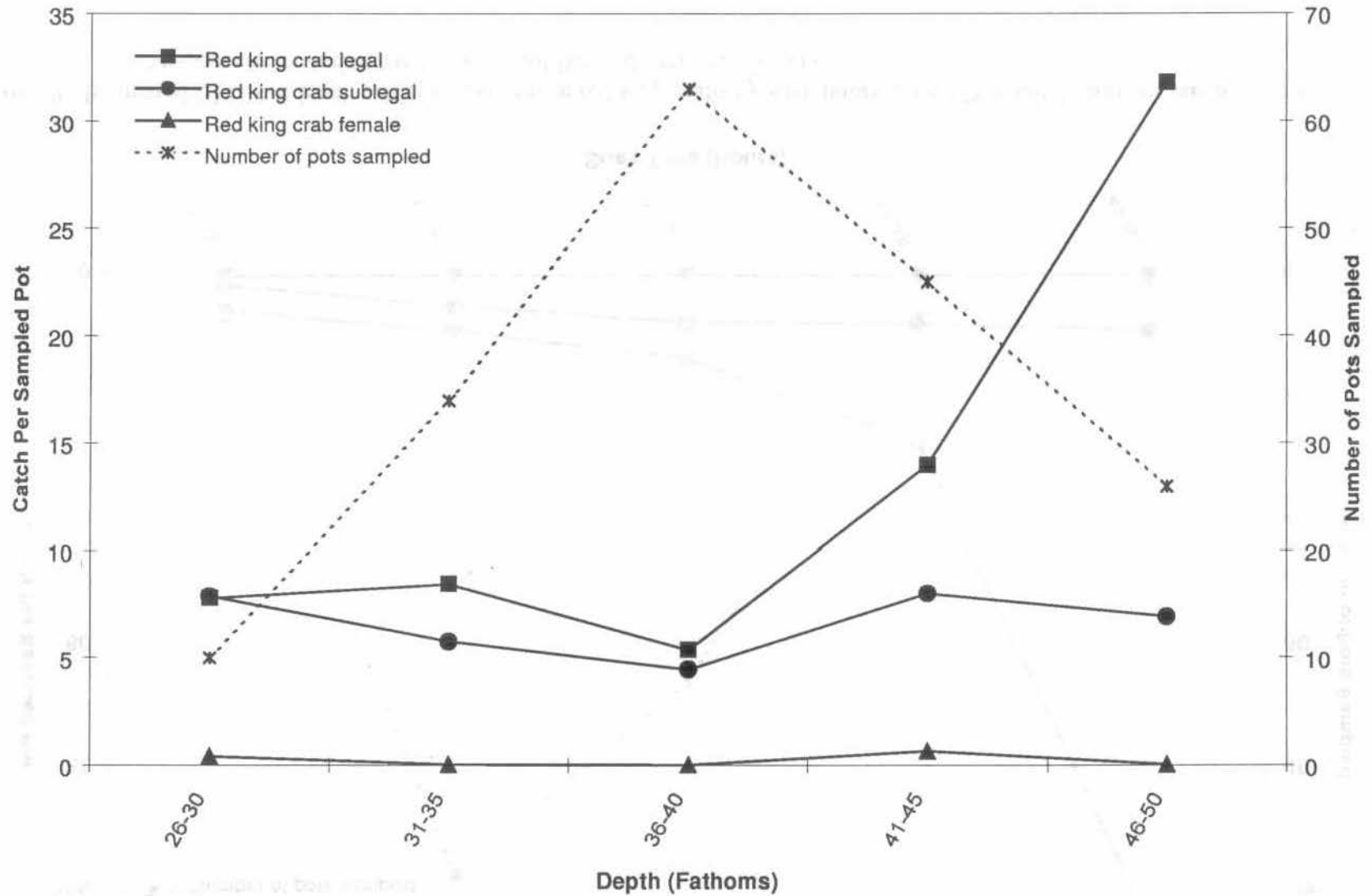


Figure 10. Estimated CPUE of legal, sublegal and female red king crabs by depth from 178 bycatch samples taken on nine catcher-processors during the 1999 Bristol Bay red king crab fishery.

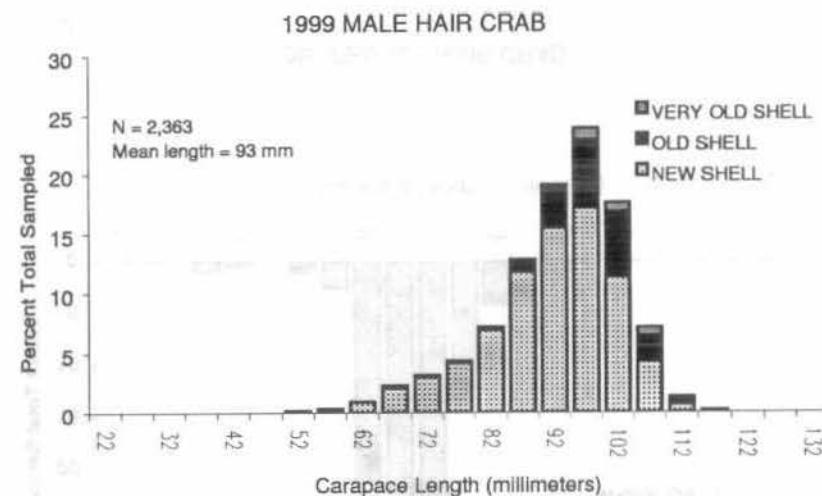
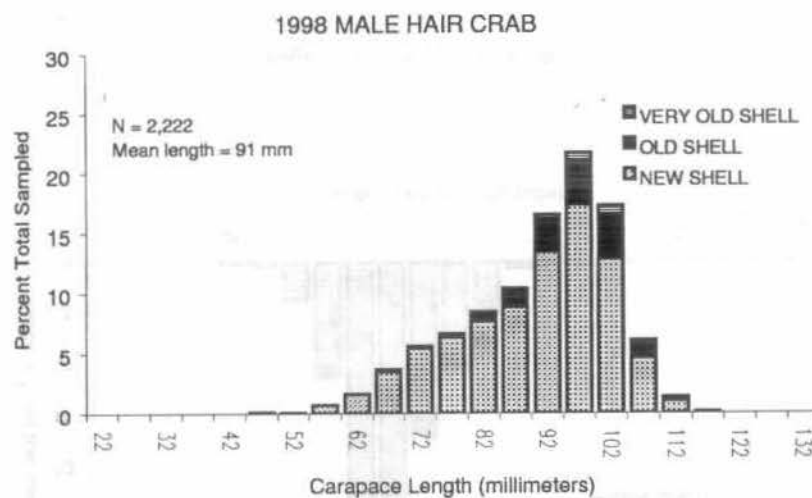
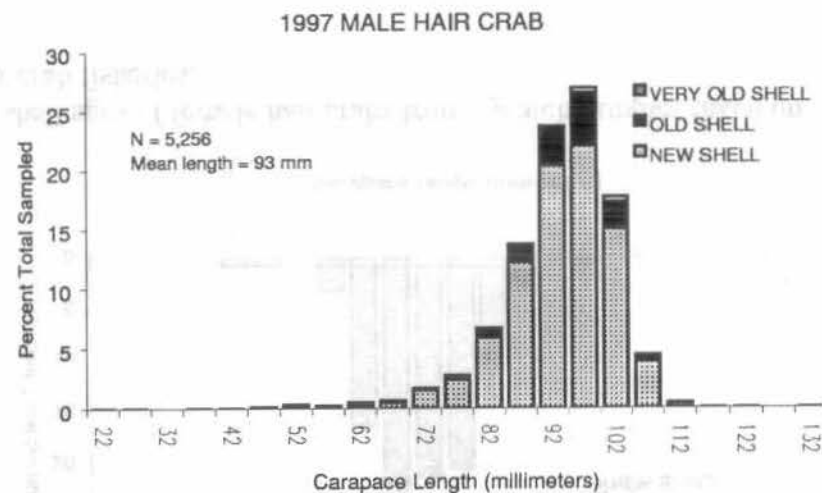
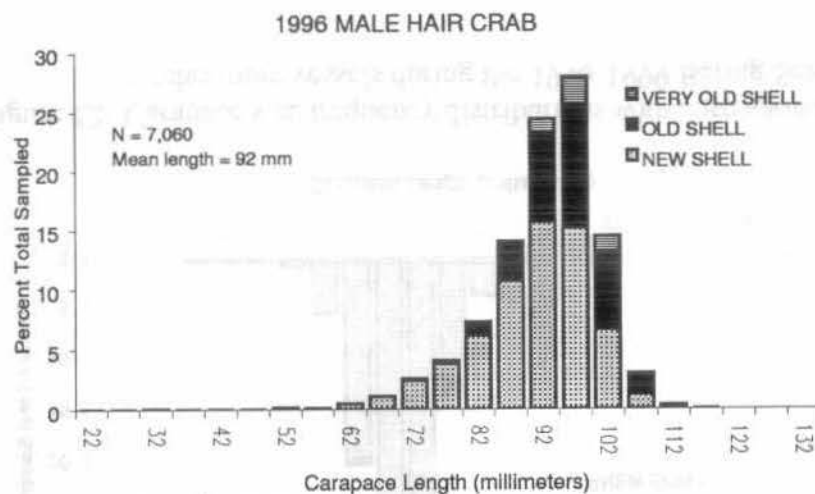


Figure 11. Carapace size frequency distributions with corresponding shell ages of male hair crabs from bycatch samples taken on catcher-only vessels during the 1996-1999 Bering Sea hair crab fisheries.

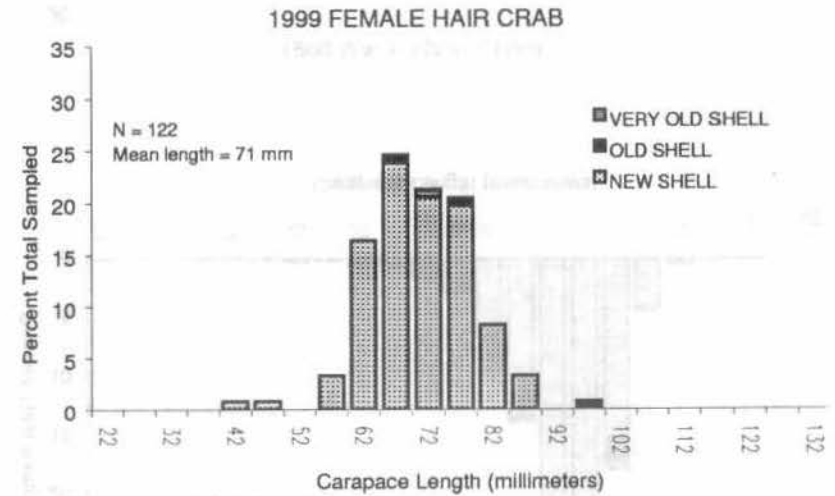
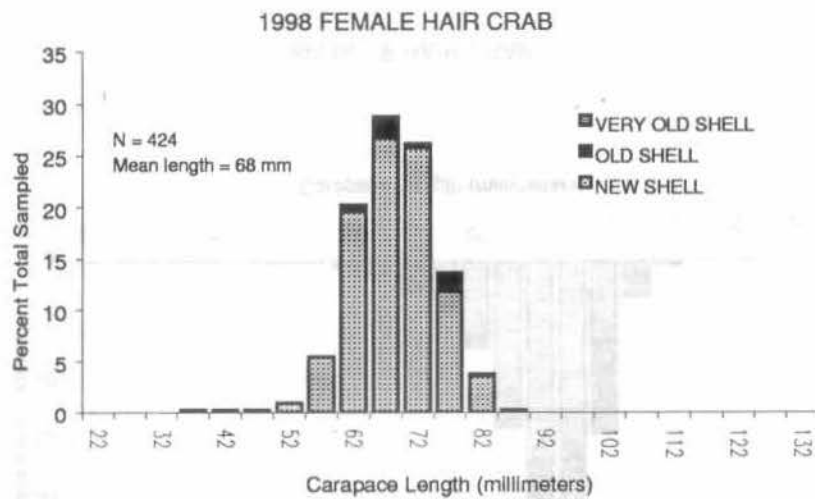
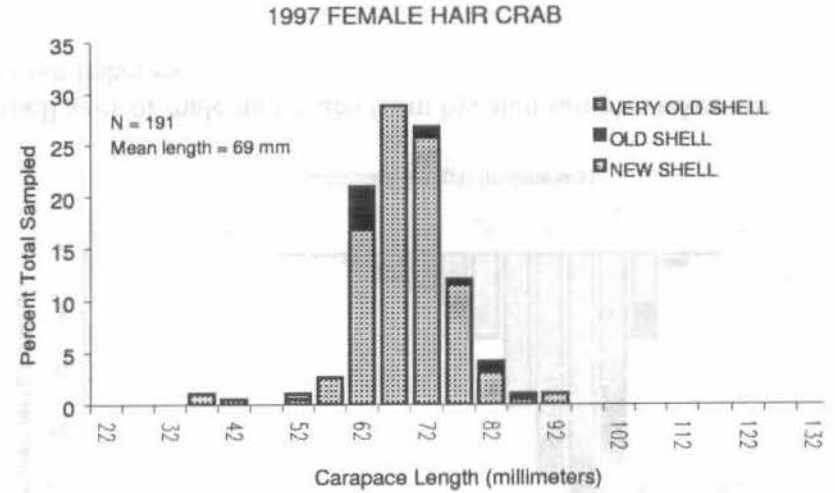
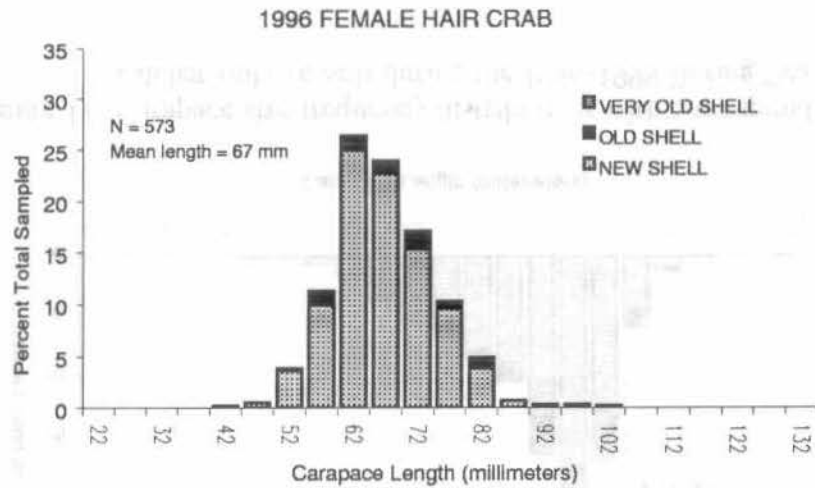


Figure 12. Carapace size frequency distributions with corresponding shell ages of female hair crabs from bycatch samples taken on catcher-only vessels during the 1996-1999 Bering Sea hair crab fisheries.

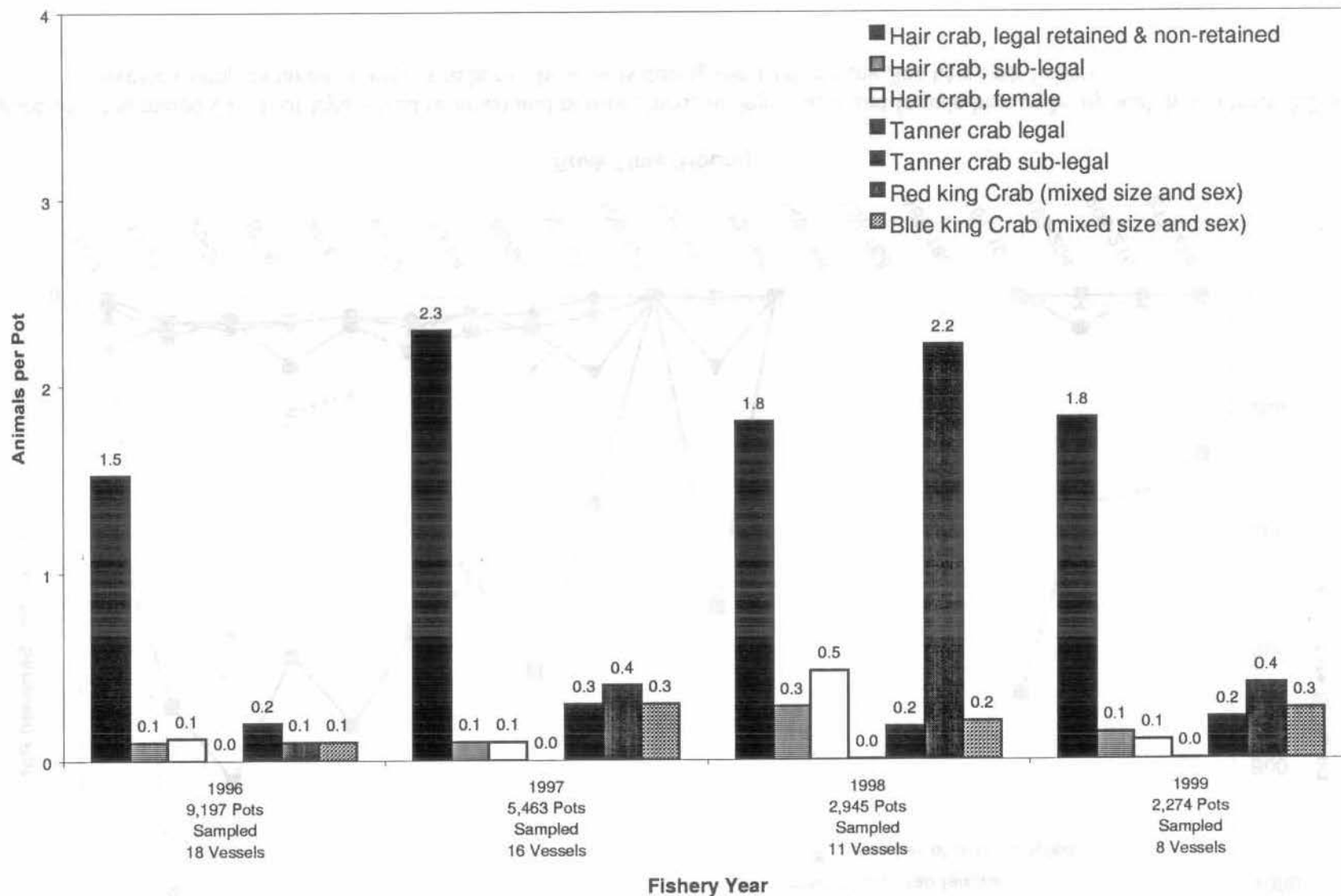


Figure 13. Estimated CPUE of selected species from bycatch samples taken on catcher-only vessels during 1996-1999 Bering Sea hair crab fisheries.

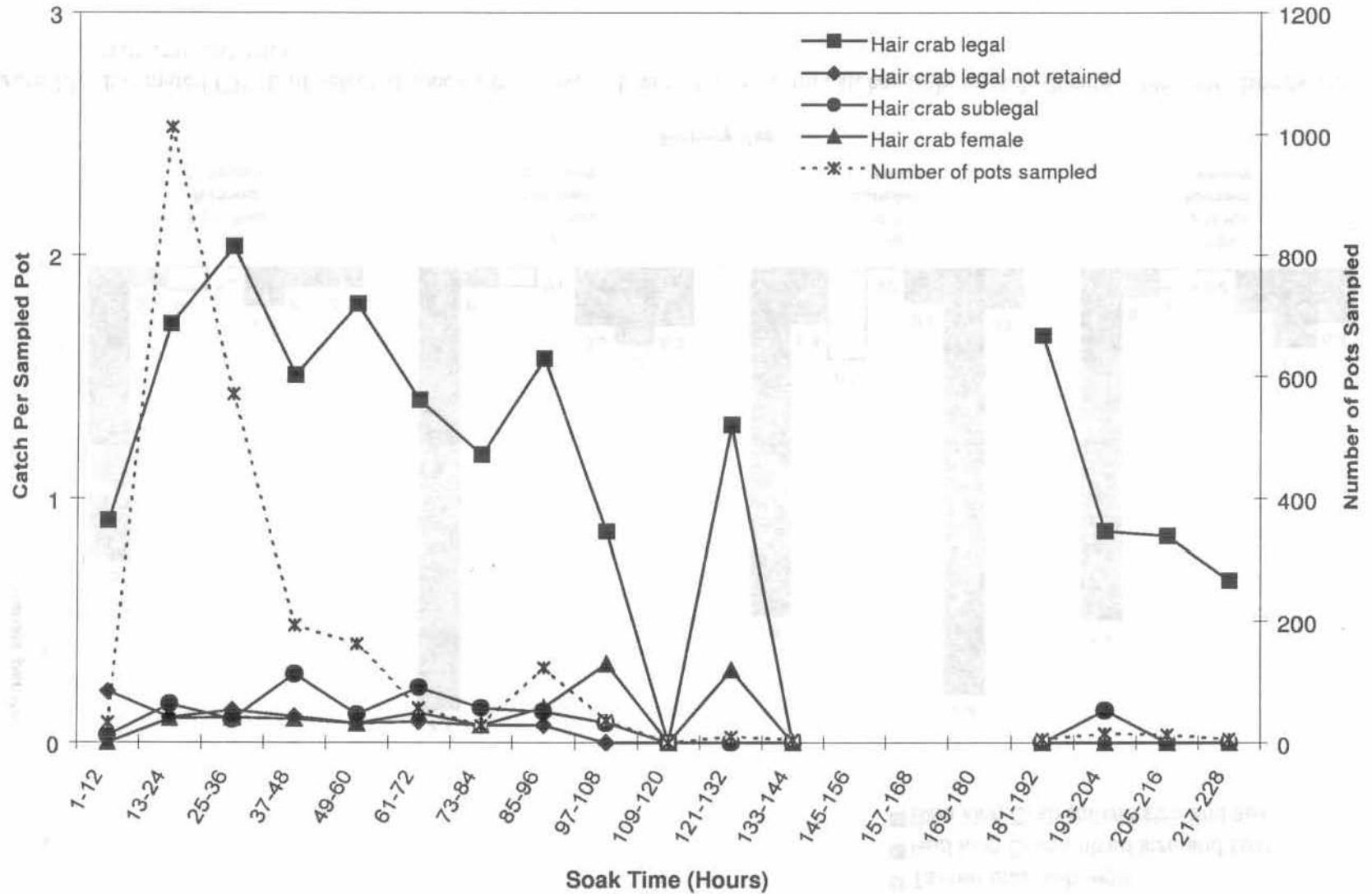


Figure 14. Estimated CPUE of legal-sized retained and non-retained, sublegal male and female hair crabs by soak hours from 2,274 bycatch samples taken on eight catcher-only vessels during the 1999 Bering Sea hair crab fishery.

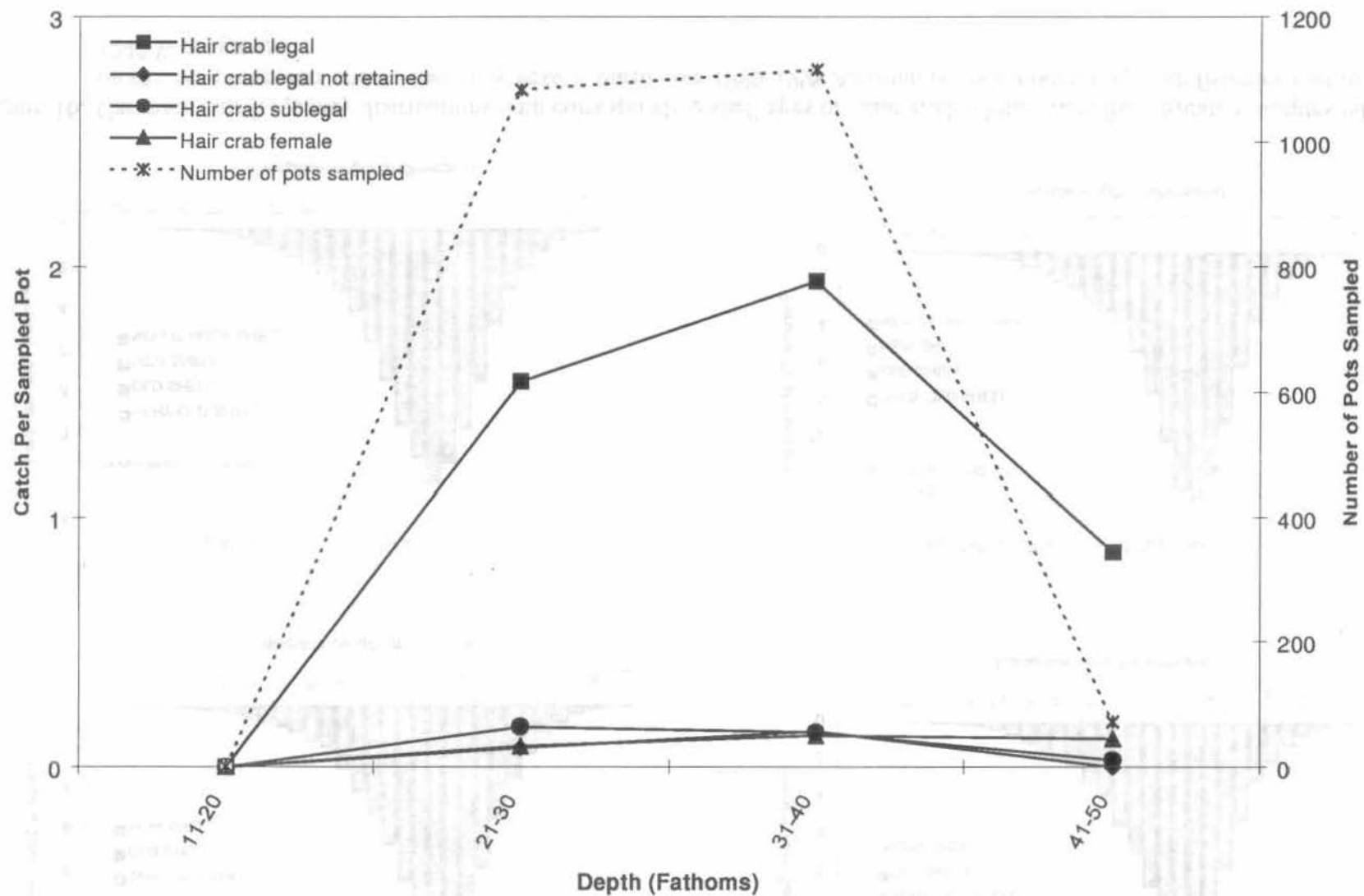


Figure 15. Estimated CPUE of legal-sized retained and non-retained, sublegal male and female hair crabs by depth from 2,274 bycatch samples taken on eight catcher-only vessels during the 1999 Bering Sea hair crab fishery.

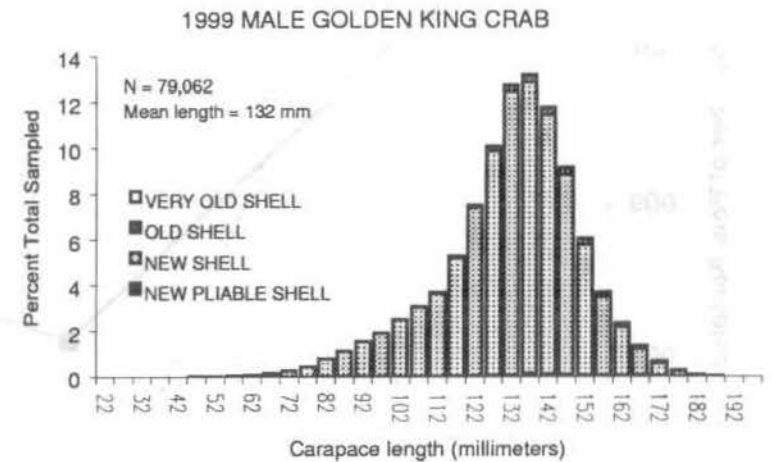
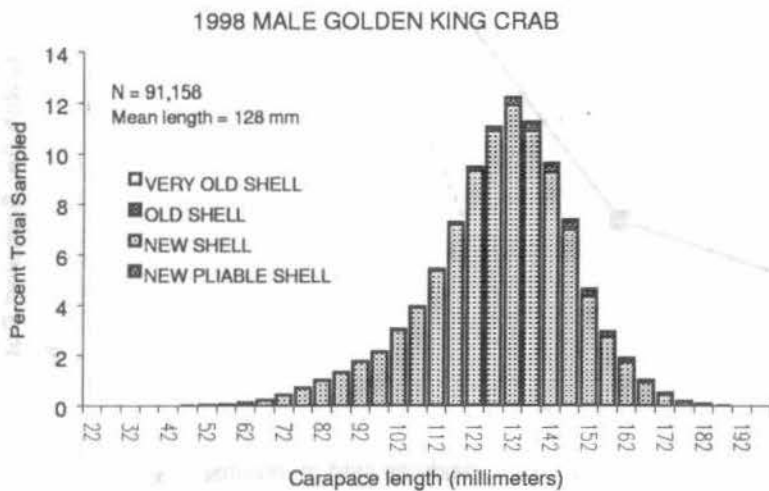
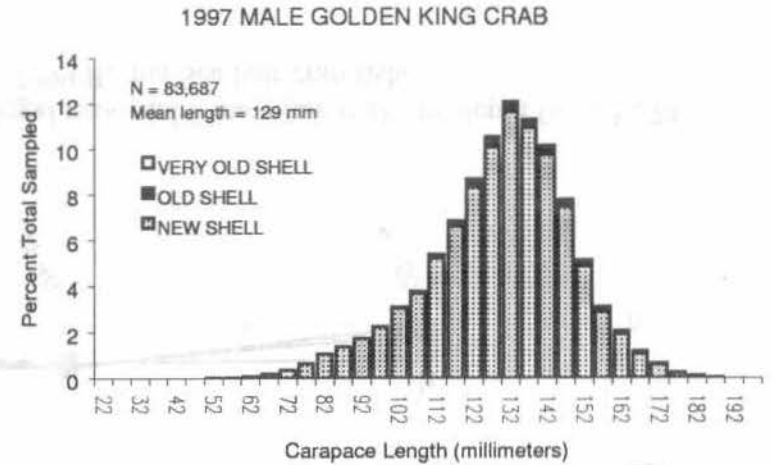
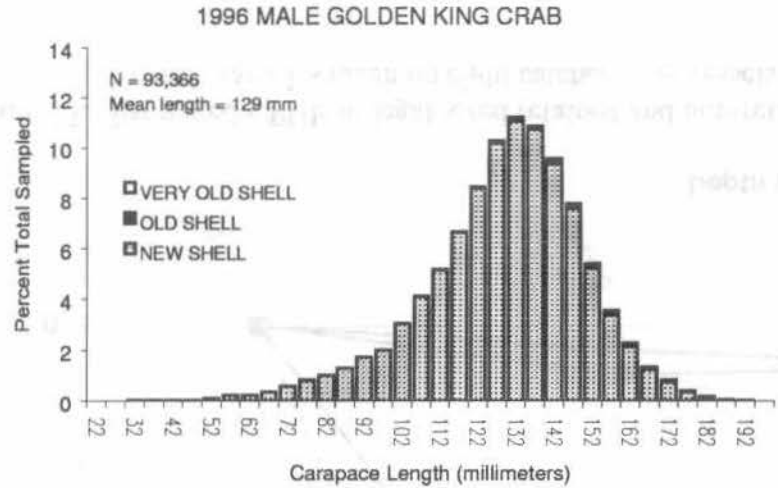


Figure 16. Carapace size frequency distributions with corresponding shell ages of male golden king crabs from bycatch samples taken on catcher-processors and catcher-only vessels during the 1996-1999 Aleutian Islands golden king crab fisheries east of 174° W longitude.

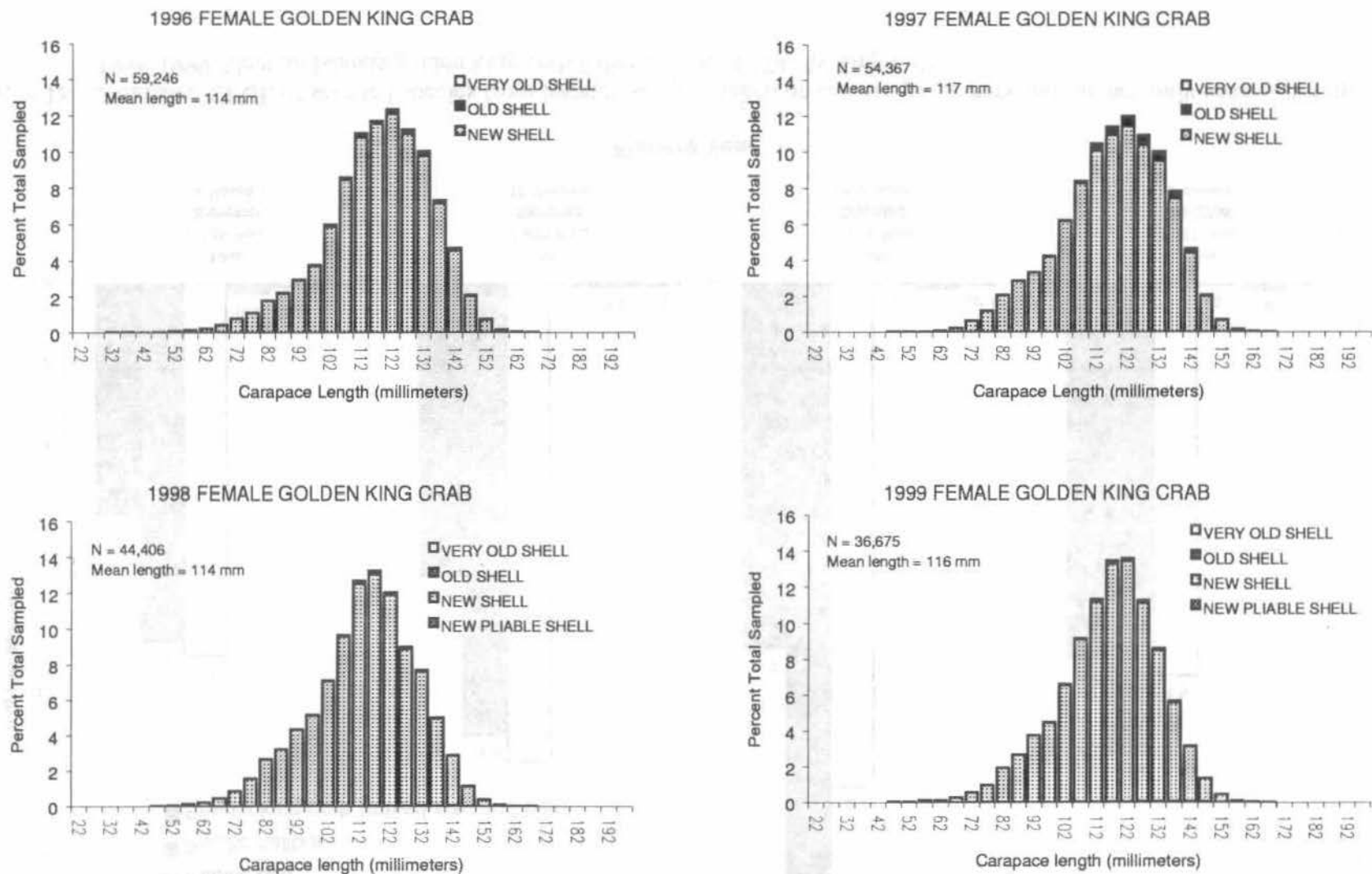


Figure 17. Carapace size frequency distributions with corresponding shell ages of female golden king crabs from bycatch samples taken on catcher-processors and catcher-only vessels during the 1996-1999 Aleutian Islands golden king crab fisheries east of 174° W longitude.

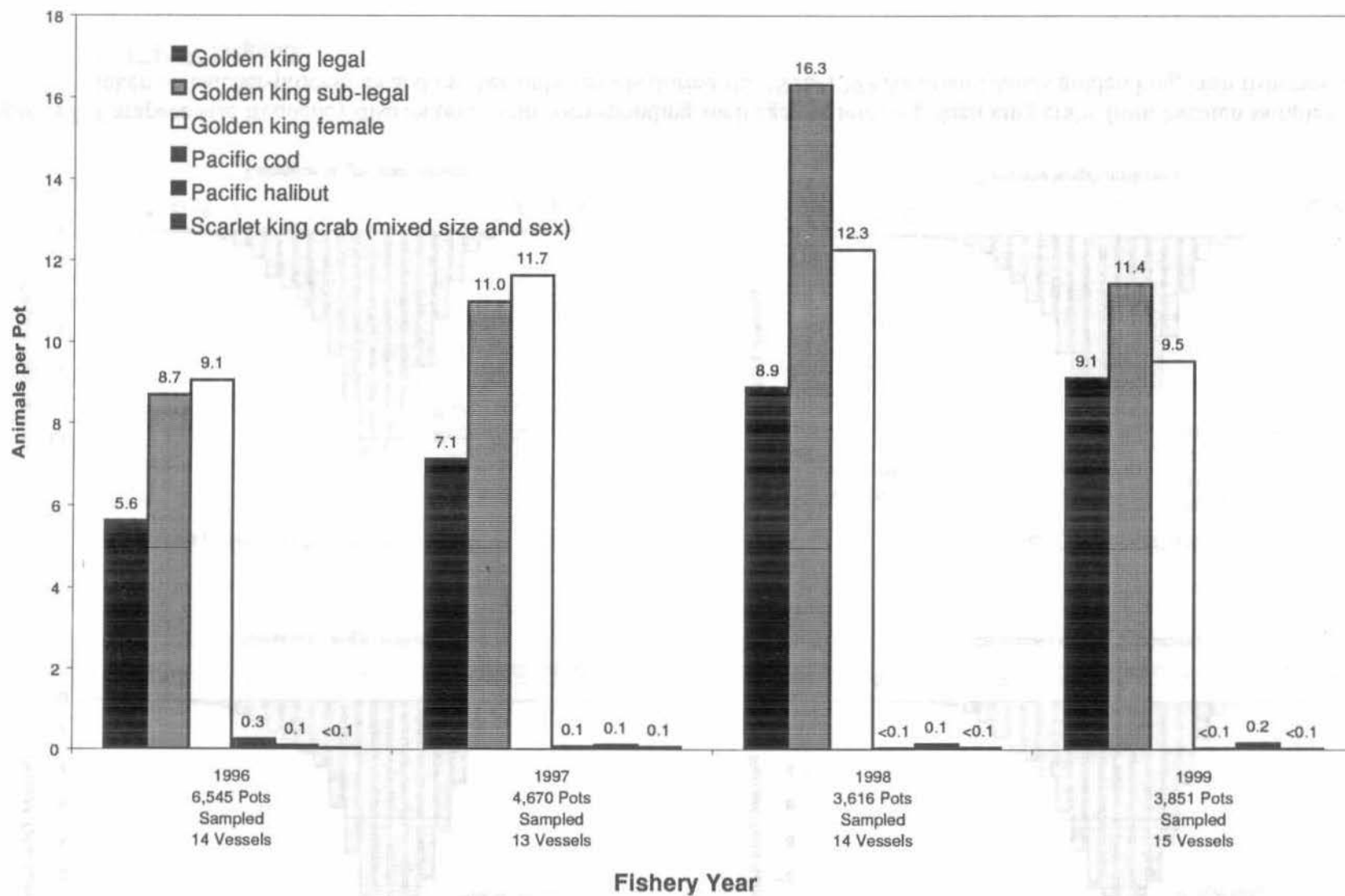


Figure 18. Estimated CPUE of selected species from bycatch samples taken on catcher-processors and catcher-only vessels during 1996-1999 Aleutian Islands golden king crab fisheries east of 174° W longitude.

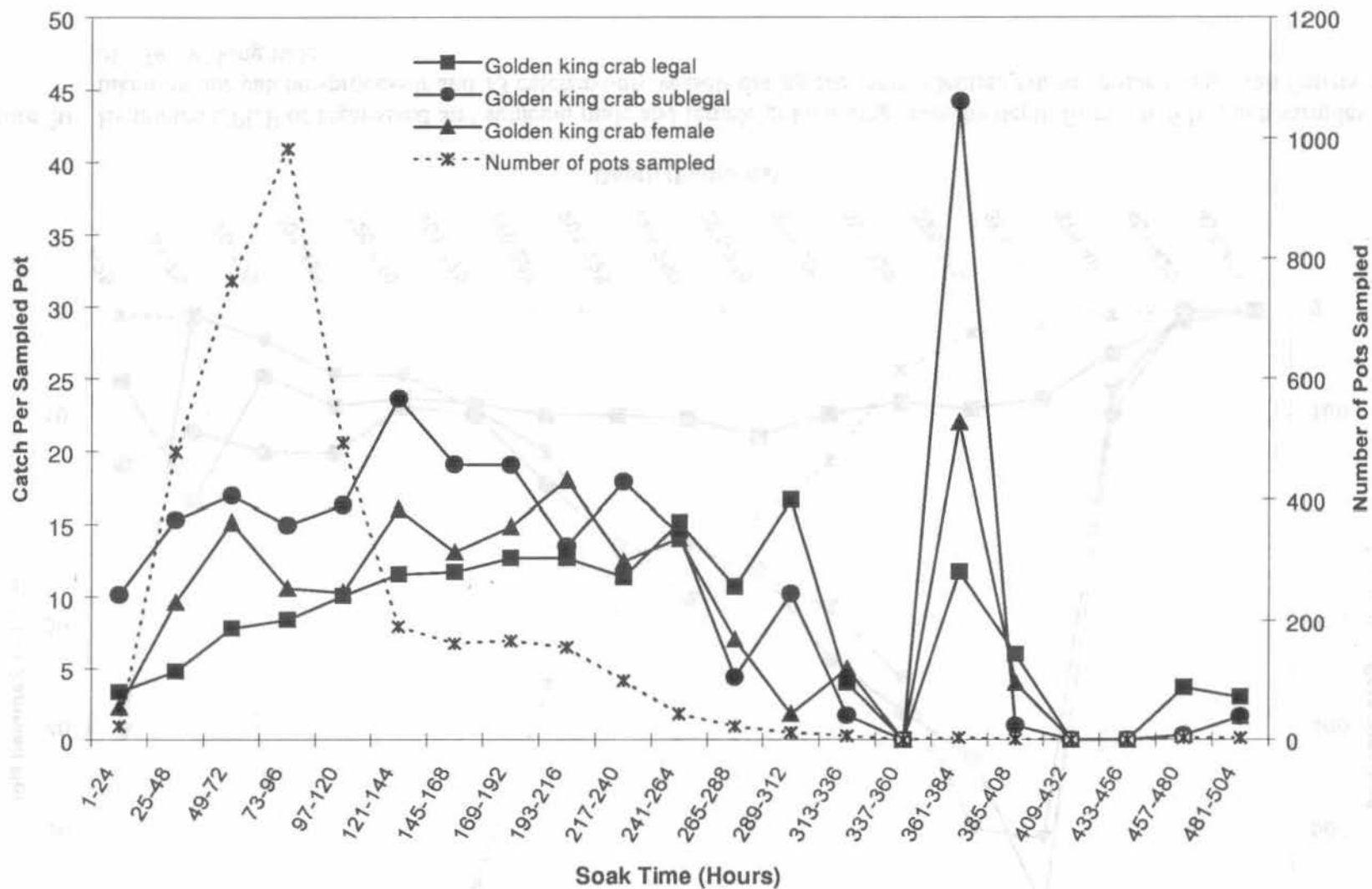


Figure 19. Estimated CPUE of legal-sized and sublegal male and female golden king crabs by soak hours from 3,616 bycatch samples taken on one catcher-processor and 13 catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery east of 174° W longitude.

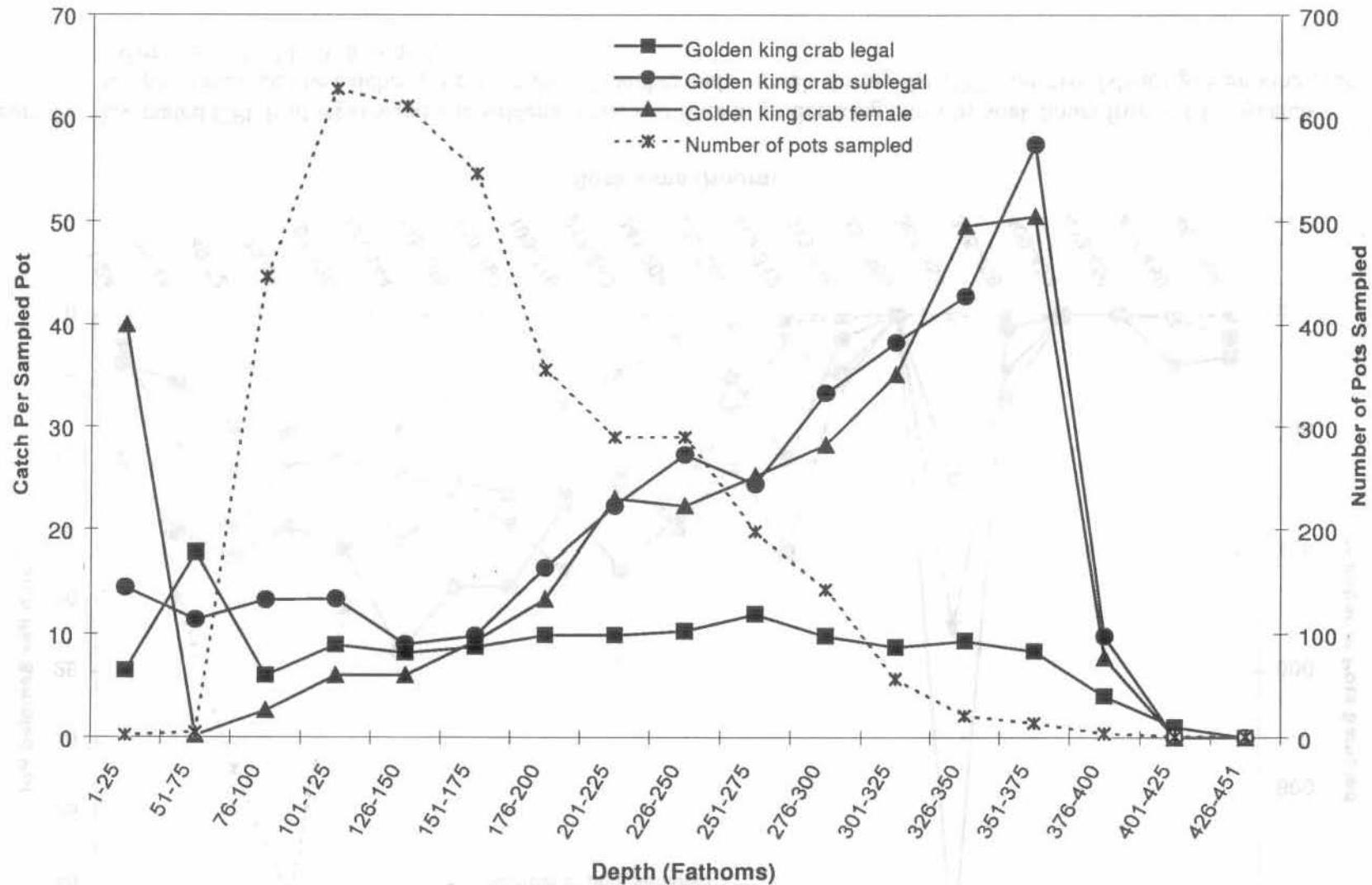


Figure 20. Estimated CPUE of legal-sized and sublegal male and female golden king crabs by depth from 3,616 bycatch samples taken on one catcher-processor and 13 catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery east of 174° W longitude.

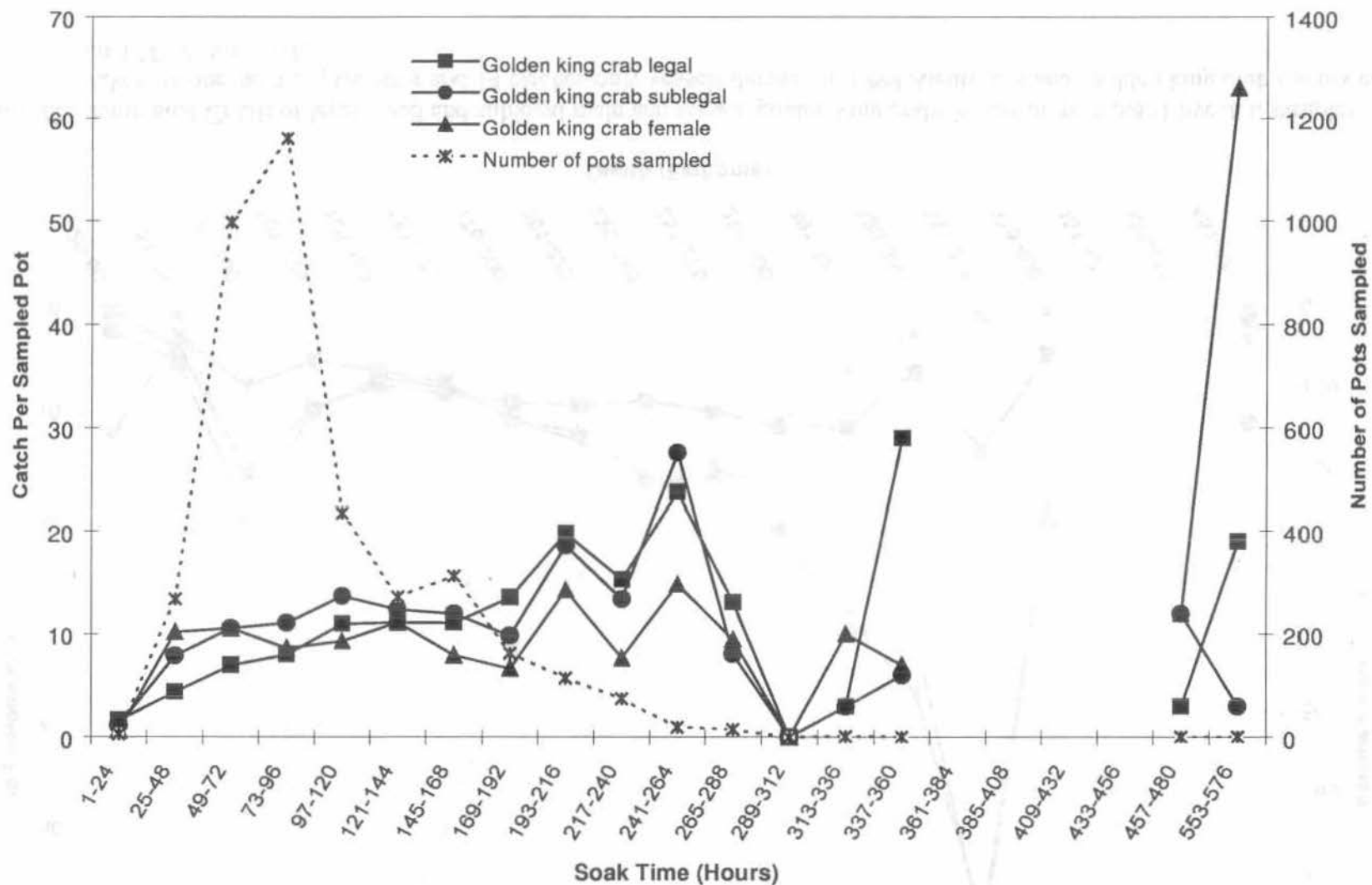


Figure 21. Estimated CPUE of legal-sized and sublegal male and female golden king crabs by soak hours from 3,851 bycatch samples taken on one catcher-processor and 14 catcher-only vessels during the 1999 Aleutian Islands golden king crab fishery east of 174° W longitude.

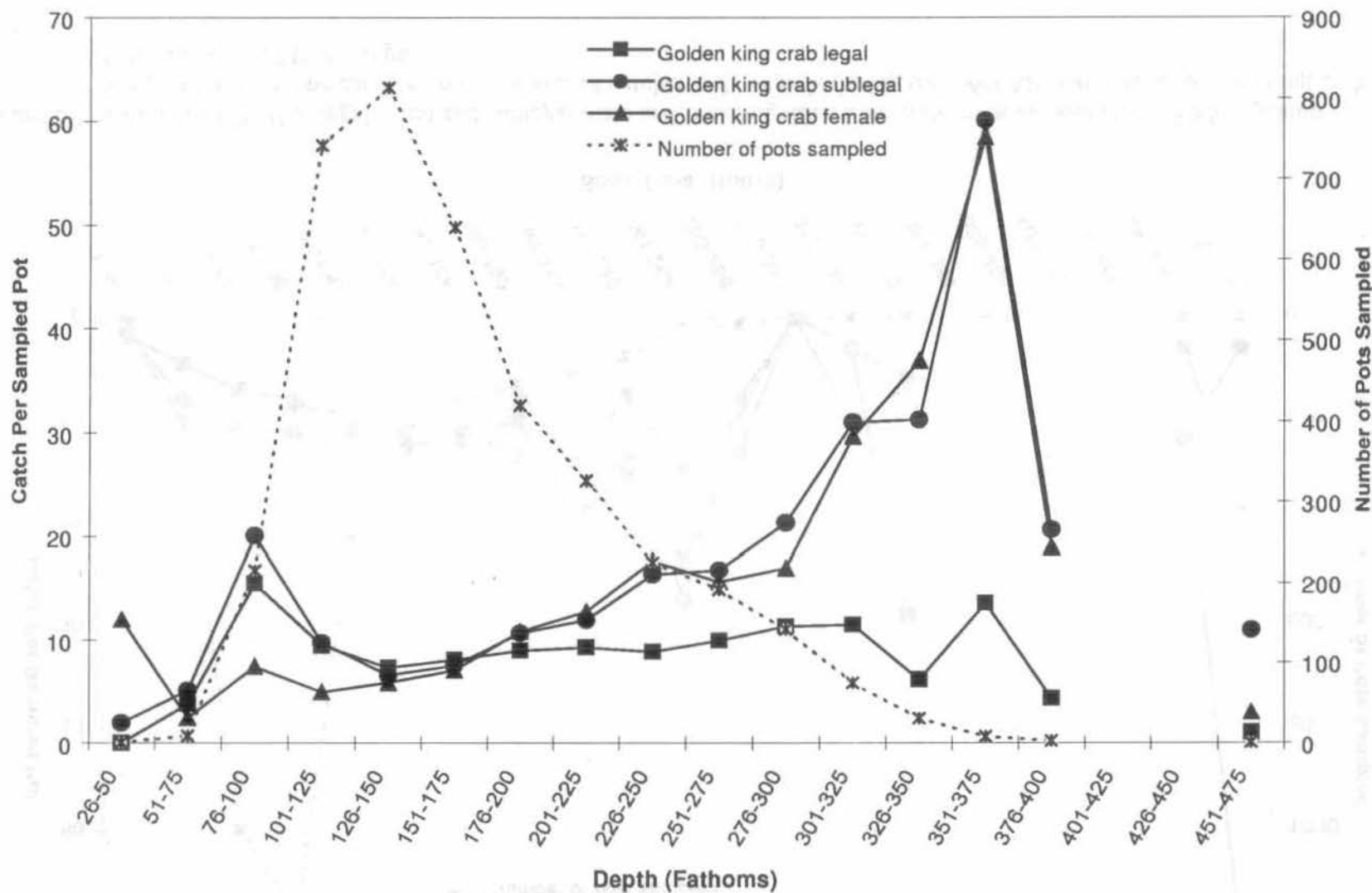


Figure 22. Estimated CPUE of legal-sized and sublegal male and female golden king crabs by depth from 3,851 bycatch samples taken on one catcher-processor and 14 catcher-only vessels during the 1999 Aleutian Islands golden king crab fishery east of 174° W longitude.

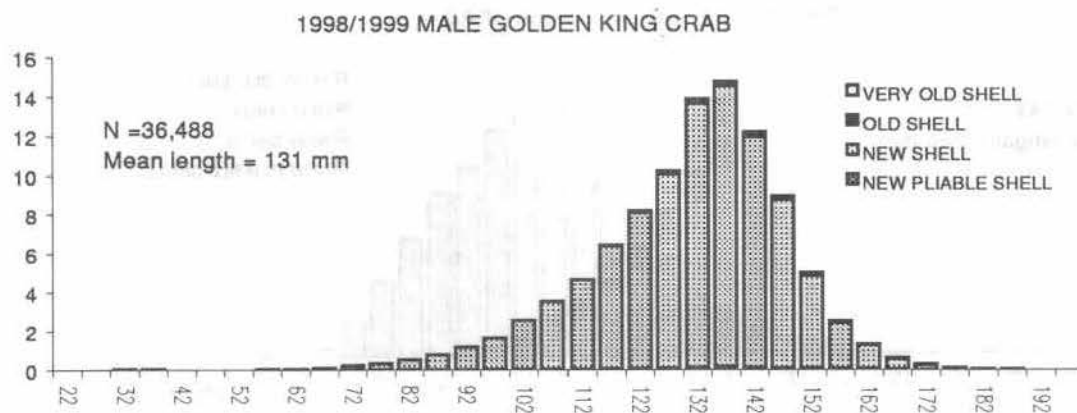
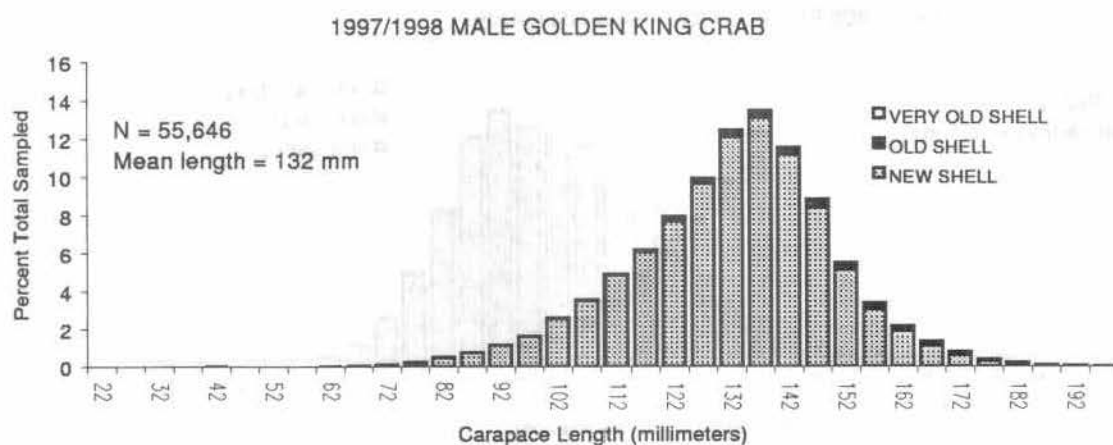
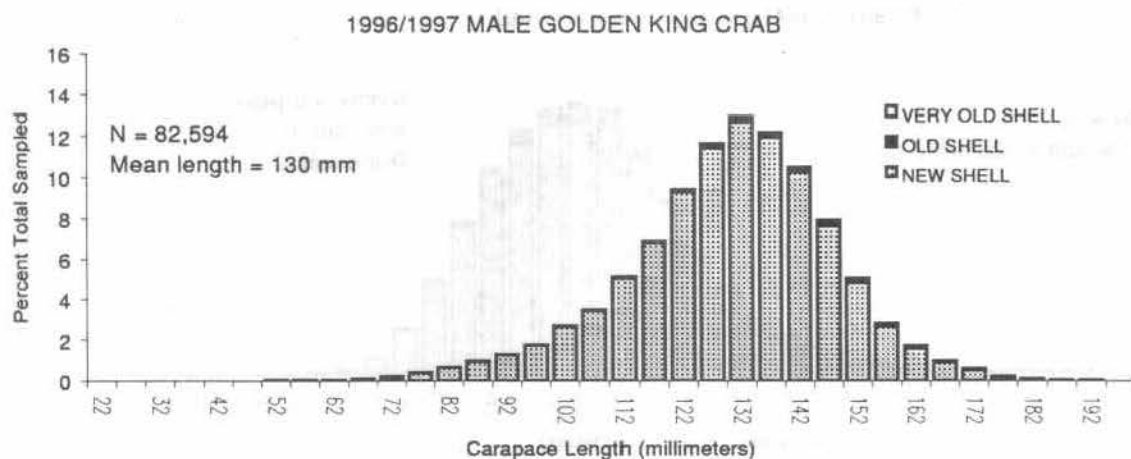


Figure 23. Carapace size frequency distributions with corresponding shell ages of male golden king crabs from bycatch samples taken on catcher-processors and catcher-only vessels during the 1996/1997 – 1998/1999 Aleutian Islands golden king crab fisheries west of 174° W longitude.

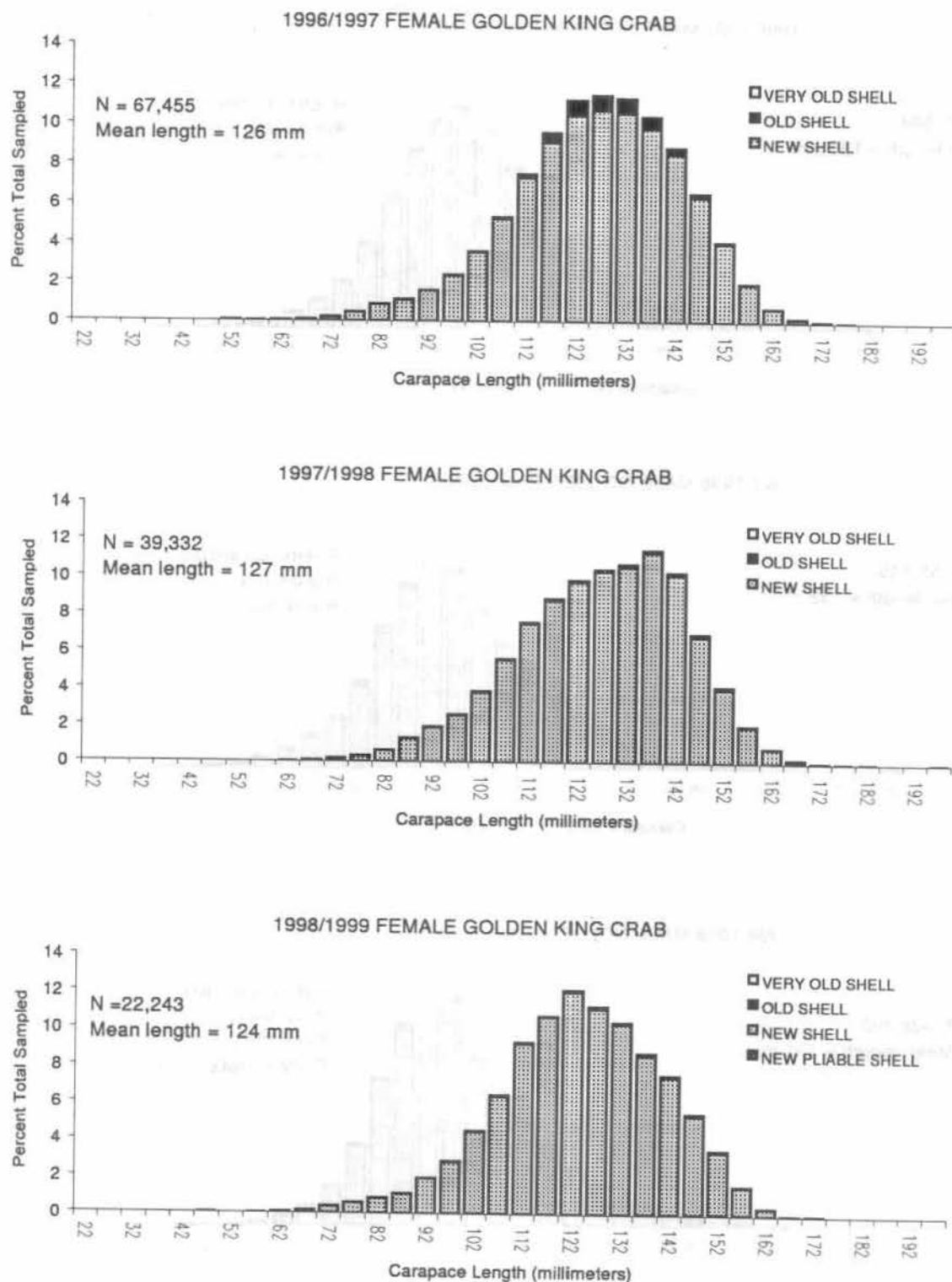


Figure 24. Carapace size frequency distributions with corresponding shell ages of male golden king crabs from bycatch samples taken on catcher-processors and catcher-only vessels during the 1996/1997 – 1998/1999 Aleutian Islands golden king crab fisheries west of 174° W longitude.

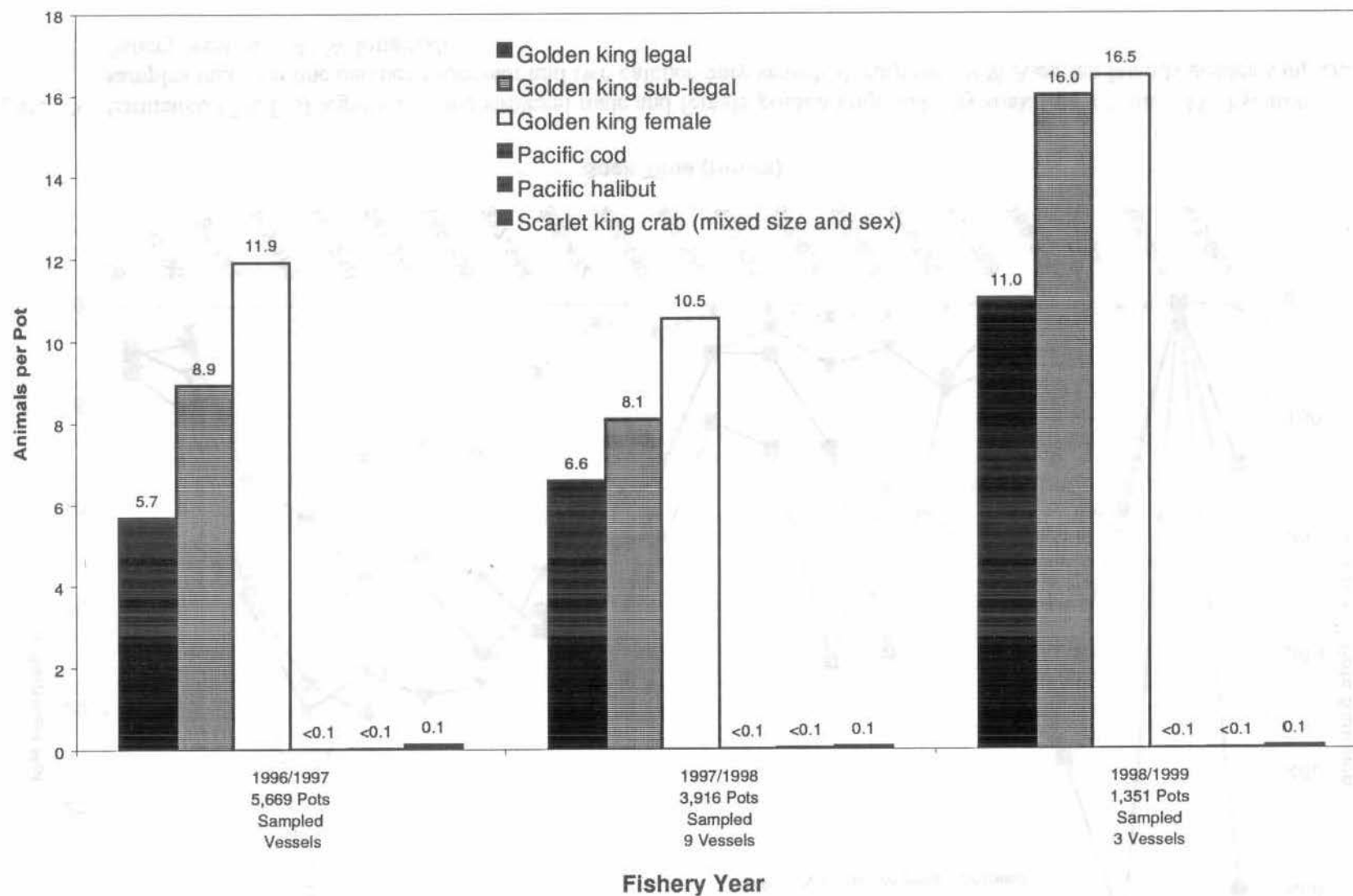


Figure 25. Estimated CPUE of selected species from bycatch samples taken on catcher-processors and catcher-only vessels during 1996/1997 – 1998/1999 Aleutian Islands golden king crab fisheries west of 174° W longitude.

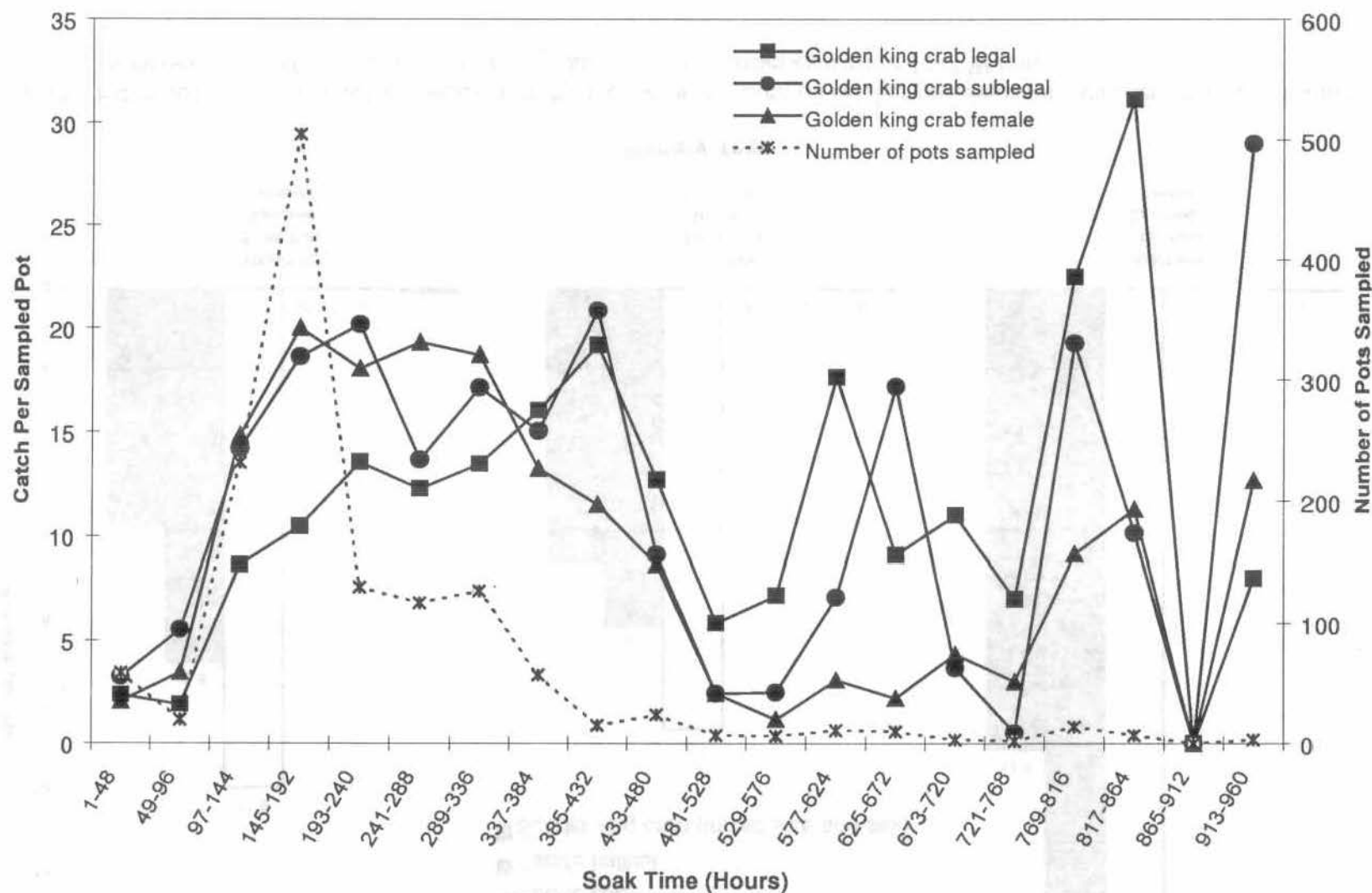


Figure 26. Estimated CPUE of legal-sized and sublegal male and female golden king crabs by soak hours from 1,351 bycatch samples taken on one catcher-processor and two catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery west of 174° W longitude.

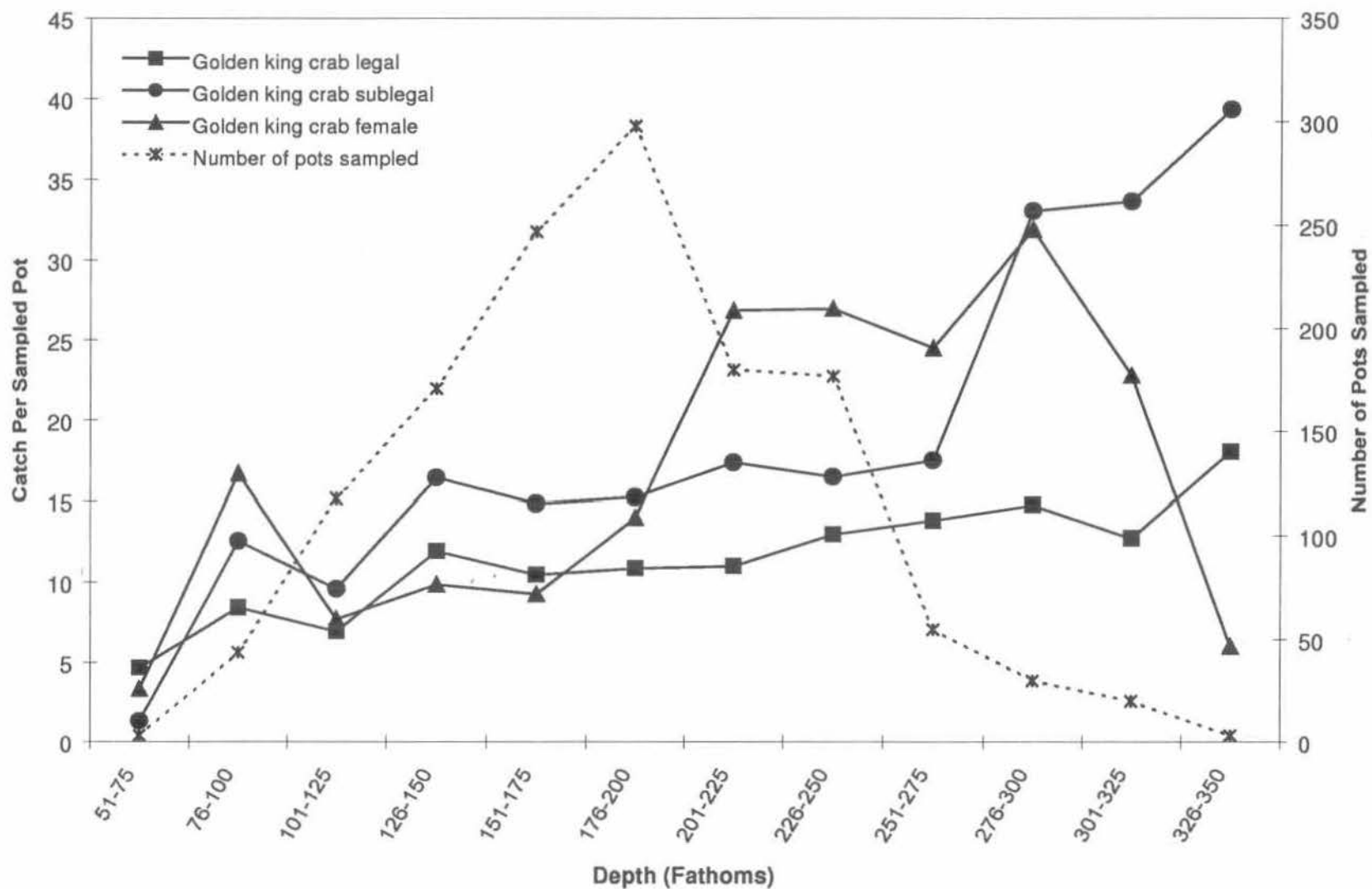


Figure 27. Estimated CPUE of legal-sized and sublegal male and female golden king crabs by depth from 1,351 bycatch samples taken on one catcher-processor and two catcher-only vessels during the 1998 Aleutian Islands golden king crab fishery west of 174° W longitude

APPENDIX

Appendix A.1. Formulas used to calculate weighted mean and variance estimates for CPUE.

For a given fishery, observers are instructed to randomly sample n potlifts per day. In practice this number will vary by day, vessel and observer. Observers actually sample n_{ij} pots per day from a total of N_{ij} pots pulled by vessel i on day j . Formulas follow Cochran (1977).

The mean cpue for vessel i on day j is

$$\bar{x}_{ij.} = 1/n_{ij} \sum_k x_{ijk}$$

and the variance for this estimator is

$$\hat{\text{var}}(\bar{x}_{ij.}) = (\sum_k (x_{ijk} - \bar{x}_{ij.})^2 / (n_{ij} - 1)) / n_{ij}$$

where x = number of crab in pot sample

i = vessel

j = day

k = pot sampled

n = number of pots sampled.

It follows that

$$(\bar{x}_{ij.})(N_{ij}) = \text{estimated total catch by vessel } i \text{ on day } j$$

$$\sum_j (\bar{x}_{ij.} N_{ij}) = \text{estimated total catch by vessel } i \text{ over the fishery}$$

$$(1/N_{i.}) \sum_j (\bar{x}_{ij.} N_{ij}) = \text{estimated weighted mean catch per pot lift by vessel } i \text{ over the fishery}$$

$$= \sum_j (\bar{x}_{ij.})(w_{ij})$$

$$= (\bar{x}_{i..})$$

and

$$\hat{\text{var}}(\bar{x}_{i..}) = \sum_j \hat{\text{var}}(\bar{x}_{ij.}) w_{ij}^2$$

where $w_{ij} = N_{ij} / N_{i.}$. The weights reflect the importance of a day's sampling based on the number of pots lifted on day j by vessel i relative to the total number of pots lifted by vessel i over the course of the fishery.

-Continued-

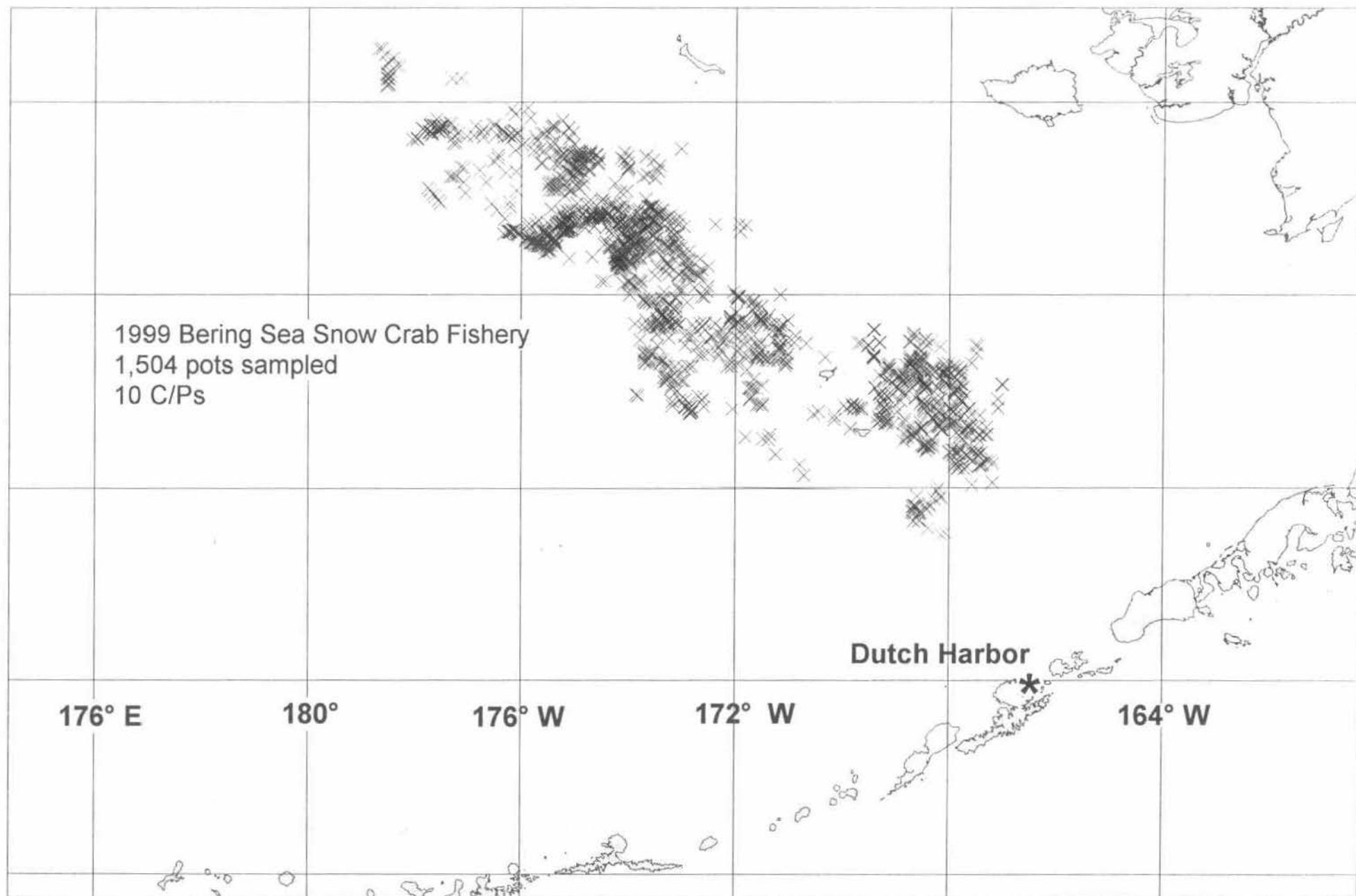
The estimated mean catch per pot lift for all vessels over the fishery is

$$\begin{aligned}\bar{x} \dots &= (1/N_{..}) \sum_i (\bar{x}_{i..}) N_{i.} \\ &= \sum_i (\bar{x}_{i..}) w_i \\ &= (1 / N_{..}) \sum_i \sum_j (\bar{x}_{ij.} N_{ij})\end{aligned}$$

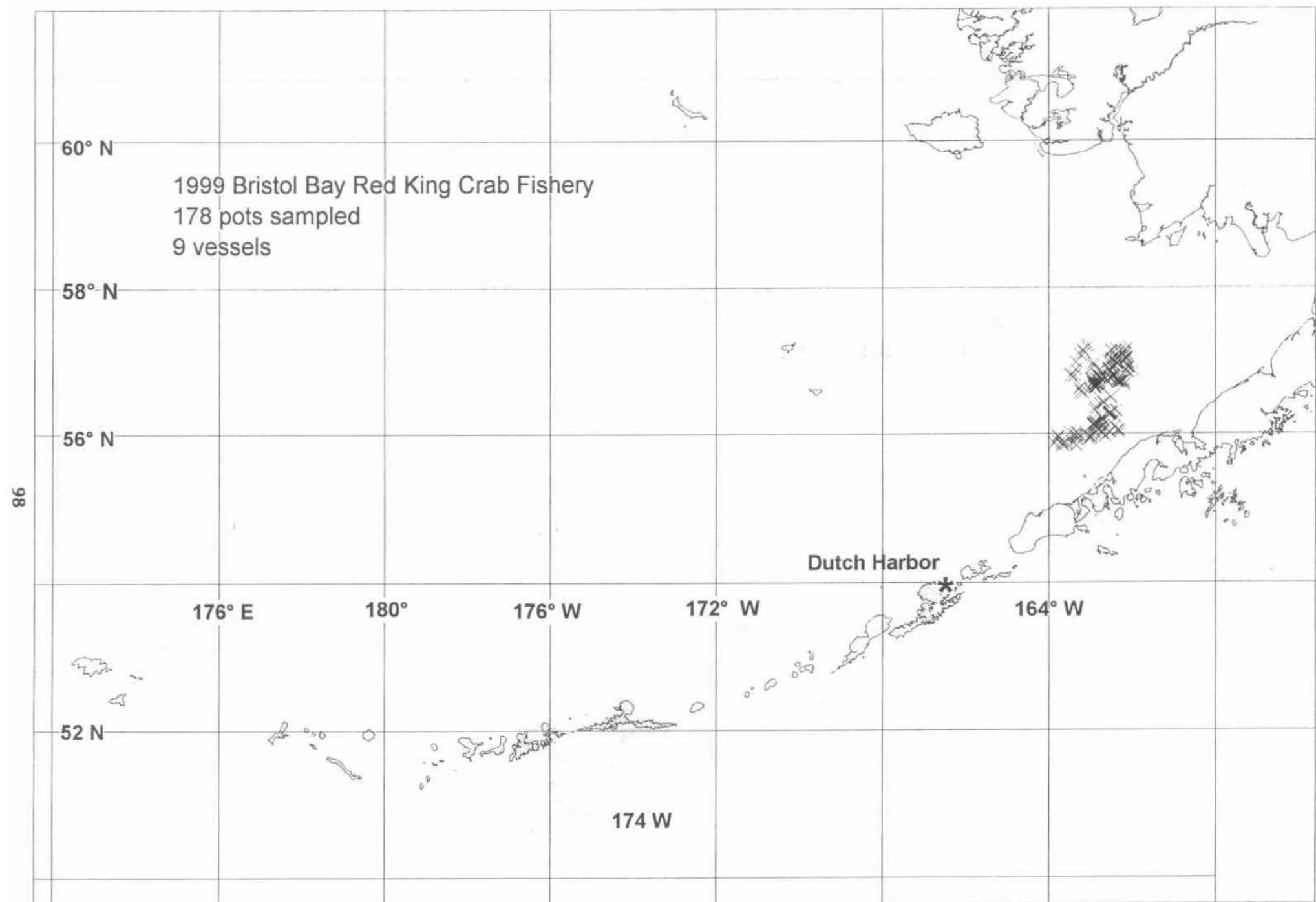
and the variance of this estimator is

$$\begin{aligned}\hat{\text{var}} (\bar{x} \dots) &= \sum_i \hat{\text{var}} (\bar{x}_{i..}) w_i^2 \\ &= \sum_i \sum_j \hat{\text{var}} (\bar{x}_{ij.}) (w_{ij}^2 w_i^2) \\ &= \sum_i \sum_j \hat{\text{var}} (\bar{x}_{ij.}) (N_{ij} / N_{i.}) (N_{i.} / N_{..}) \\ &= \sum_i \sum_j \hat{\text{var}} (\bar{x}_{ij.}) (N_{ij} / N_{..})^2 \\ &= (1/N_{..})^2 \sum_i \sum_j \hat{\text{var}} (\bar{x}_{ij.}) (N_{ij}^2)\end{aligned}$$

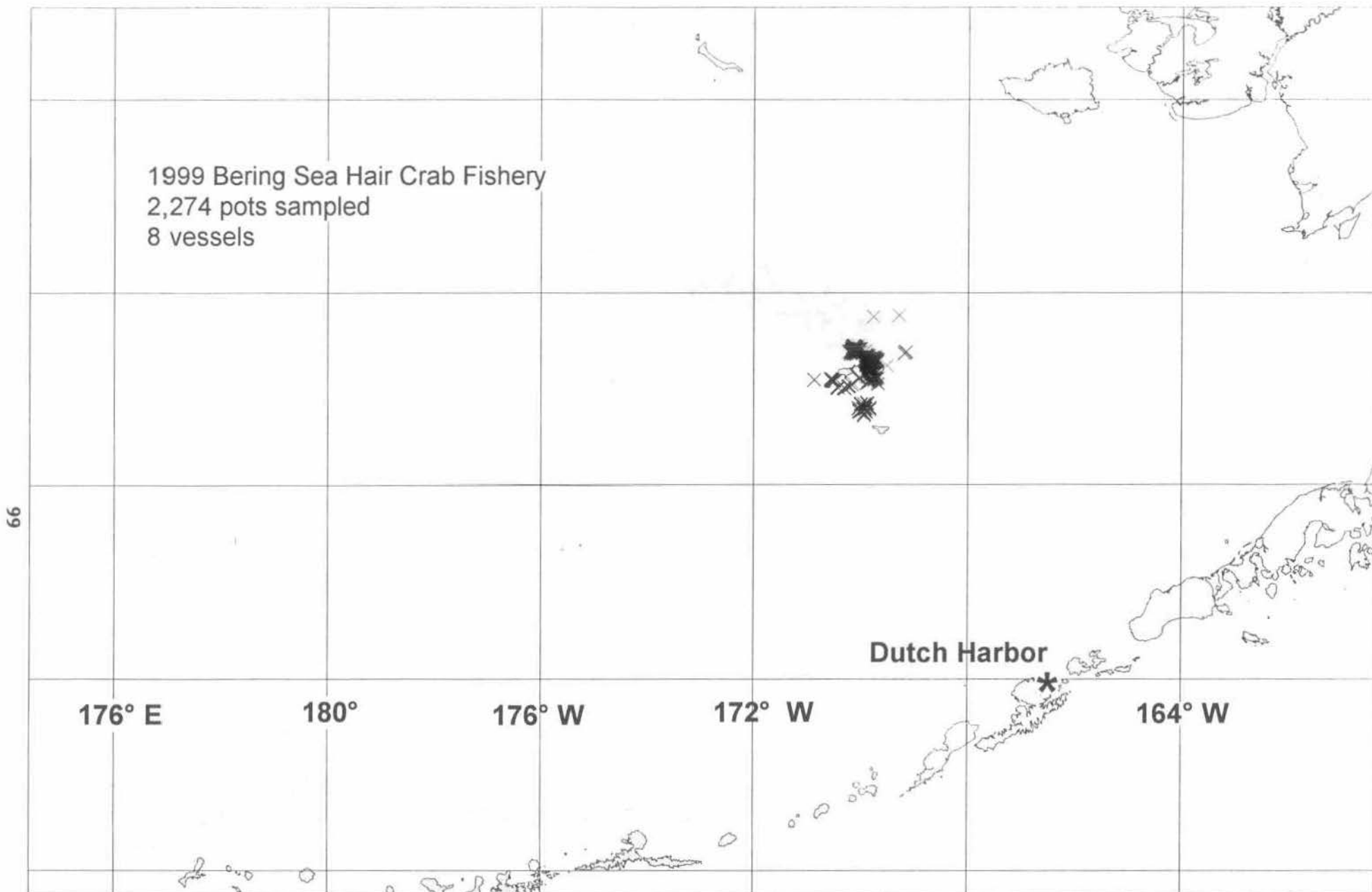
where $w_{i.} = N_{i.} / N_{..}$.



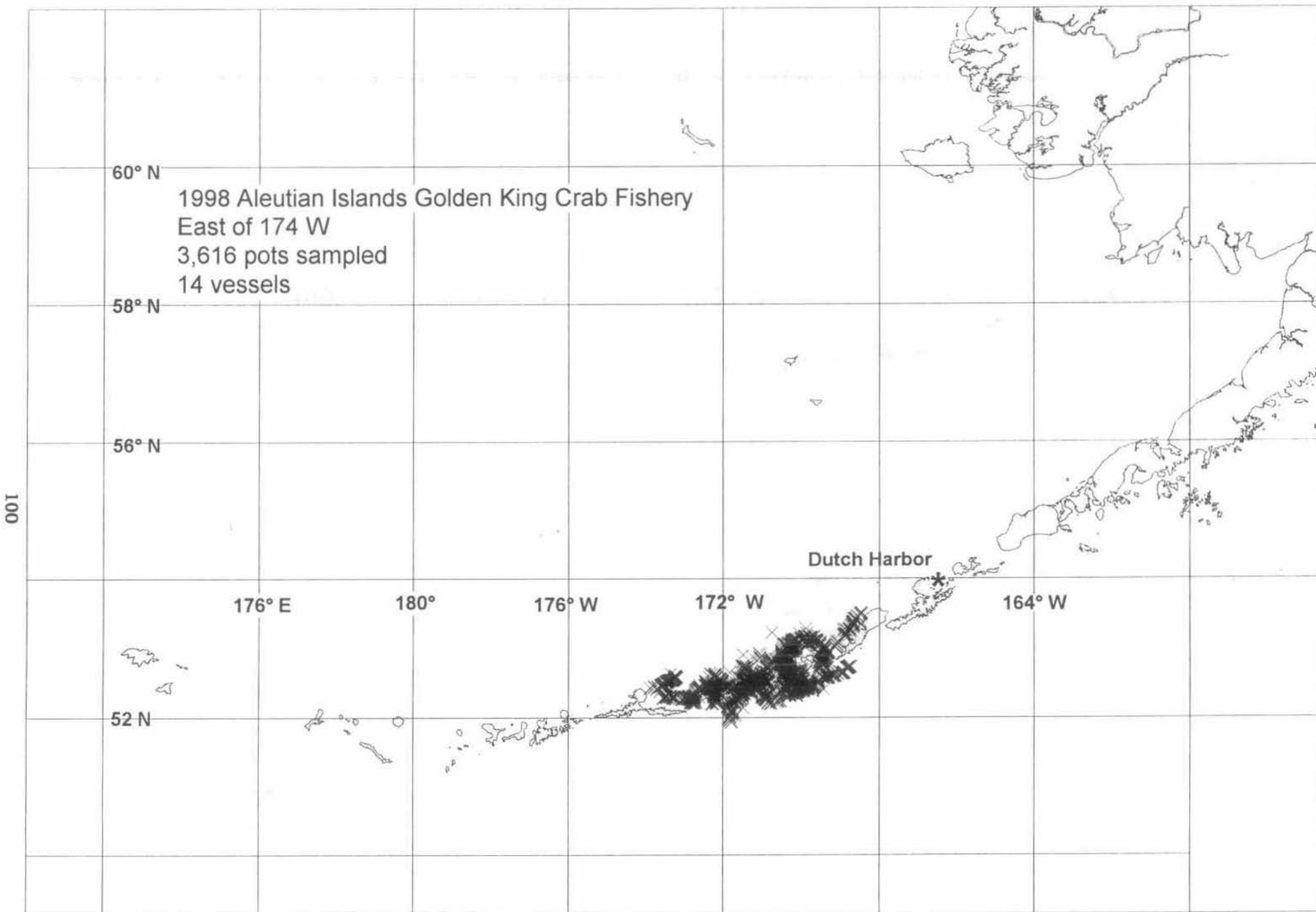
Appendix B.1. Location of pots sampled by shellfish observers during the 1999 Bering Sea snow crab fishery.



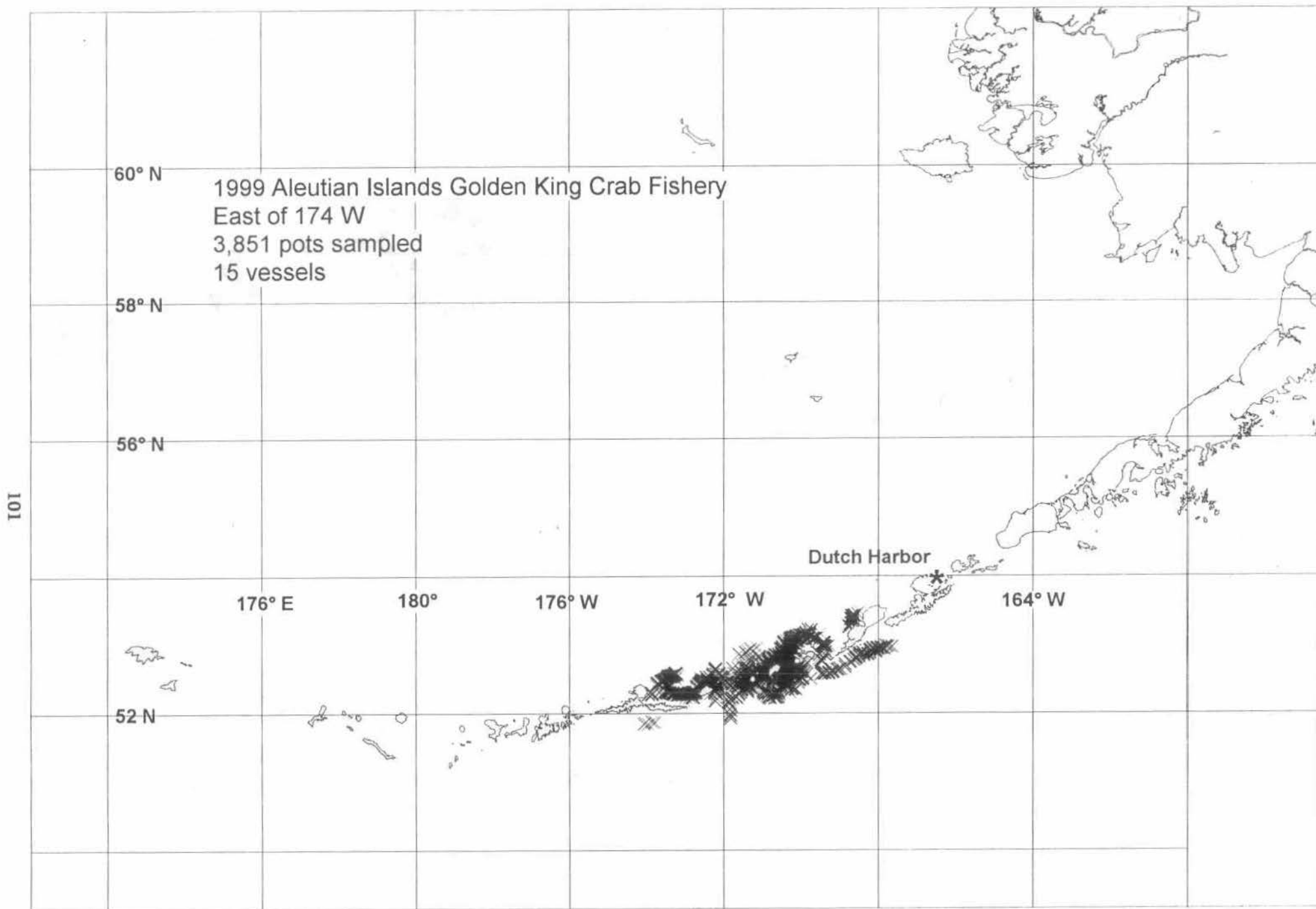
Appendix B.2. Location of pots sampled by observers during the 1999 Bristol Bay red king crab fishery.



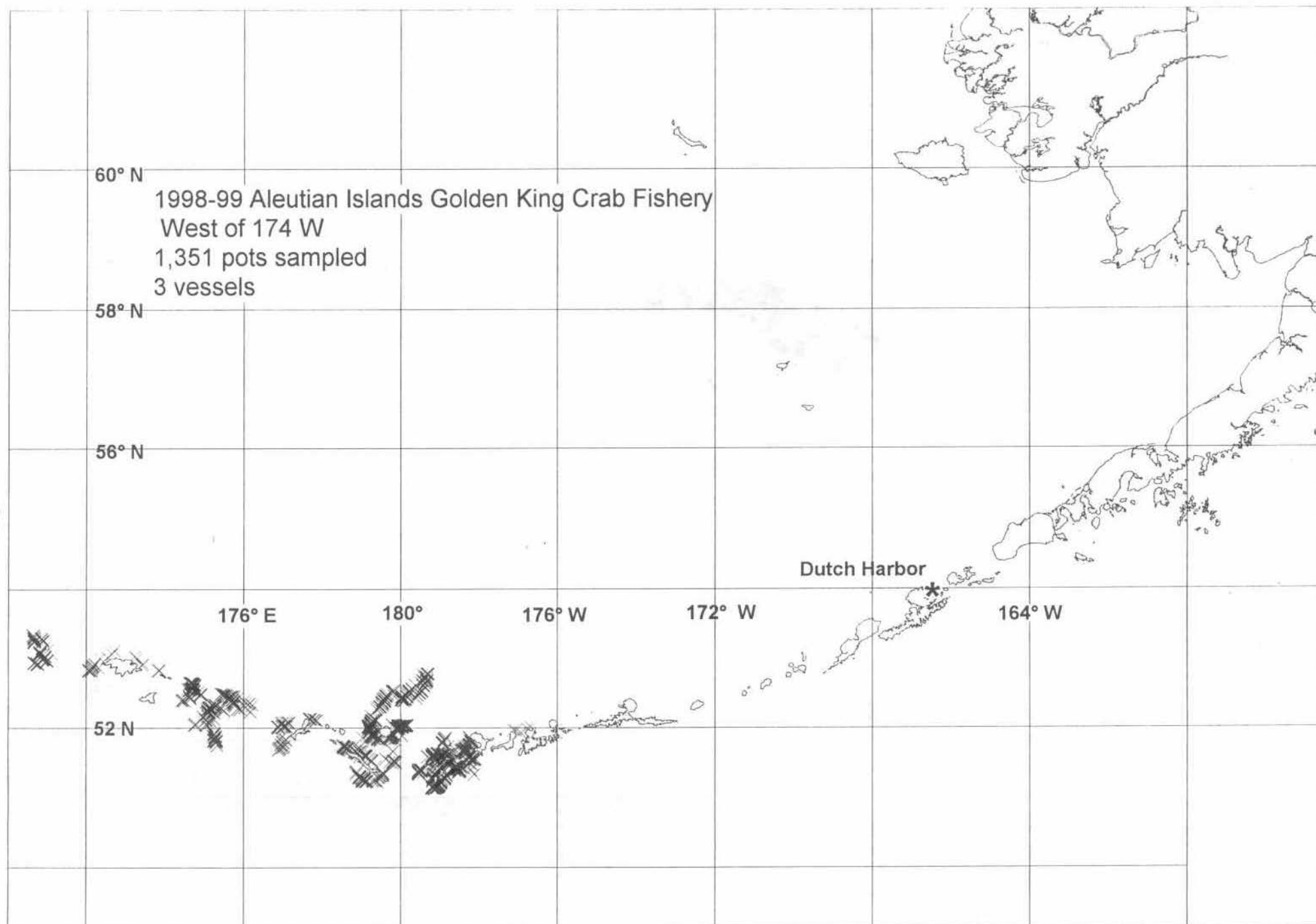
Appendix B.3. Location of pots sampled by shellfish observers during the 1999 Bering Sea hair crab fishery.



Appendix B.4. Location of pots sampled by observers during the 1998 Aleutian Islands golden king crab fishery east of 174 W.



Appendix B.5. Location of pots sampled by observers during the 1999 Aleutian Islands golden king crab fishery east of 174 W.



Appendix B.6. Location of pots sampled by observers during the 1998-99 Aleutian Islands golden king crab fishery west of 174° W.

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